US Army Corps
of Engineers
Savannah District

Fort Gillem
Georgia

Solicitation Number
DACA21-02-R-0008
U.S. Army Criminal Investigation Laboratory
FY-02, Line Item 42032
Volume VII of VII – Operation and Maintenance Requirements
With Appendix A – Management Plan & Systems Operation
Maintenance Manual - Templates
June 2002

**THIS SOLICITATION IS UNRESTRICTED PURSUANT TO THE
"BUSINESS OPPORTUNITY DEVELOPMENT REFORM ACT OF 1988"
(PUBLIC LAW 100-656)**

**U.S. ARMY ENGINEER DISTRICT, SAVANNAH
CORPS OF ENGINEERS
100 WEST OGLETHORPE AVENUE
SAVANNAH, GEORGIA 31401-3640**

(Added by Amendment No. 0002)

OPERATION AND MAINTENANCE REQUIREMENTS

VOLUME 7

Operation and Maintenance Statement of Work

INDEX OF CHAPTERS

The 'Operation and Maintenance Statement of Work' is one of three sections that document the requirements and format the submittals for a comprehensive program to provide facilities management to the Fort Gillem US Army Criminal Investigation Laboratory. The intent is that the tripartite documents be used together by the Contractor to enable an integrated systems approach to performance management.
The following documents guide the execution of the operation and maintenance mission:

- Volume 7 Operation and Maintenance Statement of Work (O&M SOW)
- Appendix A Management Plan & Systems Operation and Maintenance Manual Templates
- Specification Section 01700, Operation and Maintenance Data,

Volume 7 Operation and Maintenance Statement of Work

The intent of this Manual is to outline the scope of work required by the Operation and Maintenance phase of this contract. Chapter 1 outlines the comprehensive planning requirements as well as establishing general operational and organizational parameters supporting the execution of the work. Subsequent chapters (2-9) are organized by systems concept, and define the requirements by systems for preventive and scheduled maintenance.

Appendix A Management Plan & Systems Operation and Maintenance Manual Templates

This appendix provides two templates to be completed by the contractor during the construction period. Both documents are intended to serve as an outline of the requirements for documentation to be completed by the Contractor and will serve as a continuous reference and library throughout the duration of the contract. The manual is organized by system and in the same order as the O&M Statement of Work. Volume 1 focuses on the Comprehensive Management Plan and the subsequent volumes (2-9) will outline the processes for maintaining the building systems.

Each of the system's volumes shall explain the comprehensive operation and maintenance requirements of that specific system. The Contractor shall complete these volumes by following the specifications in Exhibit SOW-1 of the O&M Statement of Work and information obtained while completing the shop drawing process and through the construction of the facility. The first three sections, *General Information, Specific System Descriptions, and Theory of Operation*, have been prepared by the designer and describe the specific system as well as providing a discussion of the theory of operation for that system.

The Contractor should provide an overview of the information compiled in Volumes 2-9 in the form of an executive summary and include that as part of Volume 1, Comprehensive Management Plan.

Exhibits that are intended to illustrate other pertinent data are located in the last section of each systems' volume. The Contractor shall add information of a graphic or tabulation format in that section as required.

Specification Section 01700, Operation and Maintenance Data,

This section describes the overall requirements of the data to be provided for in the Operation and Maintenance aspects of the contract. Other sections identify information to be submitted during construction pertaining to Operation and Maintenance of that particular specification section.

CHAPTER

1

VOLUME 7 OPERATION AND MAINTENANCE REQUIREMENTS

Operation and Maintenance Statement of Work

Operation & Maintenance Statement of Work

Table of Contents

1.1 PERFORMANCE REQUIRMENTS

A. General

1. During the Operations and Maintenance phase of the contract, the Contractor shall operate the facilities systems of the United States Army Criminal Investigation Laboratory (USACIL); perform systematic preventive maintenance (PM); provide for continuous commissioning of critical systems; and, perform unscheduled maintenance as necessary to:

   a. Assure continuous facility operations and prevent disruptions that could adversely affect the mission of the USACIL, and,

   b. Prevent premature failure or deterioration of the facility, facilities systems, and equipment constructed or installed under the construction phase of the contract

B. Contact Scope

1. The Contractor shall furnish all labor, tools, equipment, staff and management required to perform the duties included in the scope of work for the Operations and Maintenance (O&M) phase of this contract to be accomplished at the United States Army Criminal Investigation Laboratory at Fort Gillem, GA.

C. Performance Period

1. The Contractor will provide operations and maintenance of the USACIL for a five-year period beginning the date of final acceptance of the completed facility by the Government.

D. Specific Requirements

1. The Contractor shall provide the following:

   a. Operation and Preventive Maintenance (paragraph 1.1.E).

   b. Continuous Commissioning of Critical Systems (paragraph 1.1.F).

   c. Unscheduled Maintenance (paragraph 1.1.G).

   d. Alterations and New work (paragraph 1.1.H)

   e. A Contract Facility Manager and appropriate supporting maintenance staff. (paragraph 1.2).

   f. A computer-based Facility Management System (FMS)(paragraph 1.3).

   g. Systems Operations and Maintenance Manuals (paragraph 1.4).

   h. Comprehensive Facility Management Plan (paragraph 1.5).

   i. A plan for and implementation of a transition to another organization for operations and maintenance of the USACIL after the initial 5 year O&M phase (O&M Successor) (paragraph 1.6).

E. Operation and Preventive Maintenance (CLIN 0005)

1. Operate the facility systems of the USACIL.
2. Manage the operation of the facility maintenance program, including the implementation and maintenance of a computerized Facilities Management System (FMS).
3. Perform systematic preventive maintenance (PM) and unscheduled/corrective maintenance as necessary in order to assure continuous facility operation and to prevent disruptions that could adversely affect the mission of the USACIL.
4. Take necessary actions to preserve warranties (during warranty periods).
5. Prevent premature failure/deterioration of facilities and facility systems/equipment constructed/installed under the construction portion of this contract.
6. Furnish and maintain storage bins, cabinets, and the minimum emergency stock of replacement equipment, supplies and spare parts in a place designated by the Government.

F. Continuous Commissioning of Critical Systems (CLIN 0005)

1. Continuous commissioning is a concept of maintaining critical systems and critical facility components to assure that a system reaches its expected life expectancy and that efficiency of operations is maintained throughout a system's life. Continuous commissioning not only assures that the equipment is operating at peak efficiency at start-up, but that adjustment, for environmental and operational conditions, would keep the equipment and systems performing at maximum efficency.
2. The following have been identified as critical systems for the USACIL:

<u>Division 7 – Roofing Systems</u>

3. Section 07412 – Non-Structural Metal Roofing
4. Section 07510 – Built-up Roofing
5. Section 07530 – Elastomeric Roofing

<u>Division 13 – Mechanical</u>

6. Section 13038 – Cold Storage Room

<u>Division 15 – Mechanical</u>

7. Section 15446 – Purified Water Piping
8. Section 15433 – Reagent Grade Water System
9. Section 15569 – Water Heating, Gas and Propane Air Mixture

10. Section 15620 – Liquid Chillers
11. Section 15895 – Air Supply, Distribution, Ventilation and Exhaust System Custom Air Handling Equipment
12. Section 15951 – Direct Digital Control for HVAC

Division 16 – Electrical

13. Section 16261 – Variable Frequency Drive Systems under 600 volts
14. Section 16263 – Diesel Generator Set Stationary 100-2500 kW, with auxiliaries
15. Section 16265 – Uninterruptible Power Supply (UPS) System above 15kVA Capacity
16. Section 16410 – Automatic Transfer Switch and by Pass/Isolation Switch
17. Section 16415 – Electrical
18. For these critical systems, the Contractor has total responsibility for all maintenance and repair during the 5 year O&M period without additional compensation by the Government, except for acts of God.
19. The Contractor shall implement a Continuous Commissioning Program that measures and compares the condition and performance of each of the critical systems against the condition and performance at the time of acceptance of the facility at the completion of construction. The Contractor shall submit for the Contracting Officer's approval the conditions to be evaluated and the performance criteria to be measured 60 days prior to acceptance of the facility. Upon acceptance of the facility the conditions and performance data shall be documented and will serve as the baseline criteria for future comparison.
20. Formal assessments will be conducted during the sixth month of the O&M phase of this contract, after the 12th month, and thereafter annually.
21. As a part of the continuous commissioning process, the Contractor will take whatever actions are necessary to bring the critical systems back into the conditions and within the operating performance parameters that were identified in the baseline criteria. These actions including all necessary labor, materials, and services will be at no additional cost to the Government.
22. The Continuous Commissioning Program shall not be construed to be a substitute for Preventive Maintenance and Unscheduled Maintenance specified elsewhere in the O&M Statement of Work.
23. All work for Continuous Commission of Critical Systems shall be paid under CLIN 0005.

G. Unscheduled Maintenance (CLINs 0005 & 0006)

1. General

a. The Contractor will be required to perform unscheduled maintenance within the site boundaries of the United States Army Criminal Investigation Laboratory (USACIL)

2. Payment

a. Unscheduled Maintenance is covered under one of two contract line items in the schedule depending on the dollar value of the action as described below. NOTE: Unscheduled maintenance and repairs up to and including replacement of Critical Systems is the sole responsibility of the contractor and is not covered under this section.

b. Unscheduled Maintenance $750 or less per event (CLIN 0005): All unscheduled maintenance events that are less than $750 will be carried out by the contractor and documented in the FMS. The cost for these events will be borne by the Contractor's monthly payment for CLIN 0005. No additional payment will be made for this work.

c. Unscheduled Maintenance greater than $750 per event (CLIN 0006): Unscheduled maintenance events exceeding $750 will be ordered by the Government representative using a Service Order (SO). The Contractor shall provide unscheduled maintenance under this category, as required, during the 5-year O&M of the facility in a total amount not to exceed the amount shown on CLIN 0006 of the contract. All Services Orders will be documented and tracked in the FMS.

d. The costs for unscheduled maintenance includes all elements of expense to the Contractor including labor, materials, overhead, and profit to complete the specific maintenance event.

3. Service Orders

a. The Contracting Officer's Representative (COR) will issue SOs for unscheduled maintenance exceeding $750 using a format developed by the Contractor for this purpose. SOs will be processed as outlined below:

b. When the Government or the Contractor identifies a requirement for unscheduled maintenance exceeding $750, the Government will define the general scope of the work and request the contractor to prepare a proposal to include the expected time to complete the action, a schedule of cost to include labor categories and labor hours, and materials necessary to complete the work.

c. The contractor and the Government will meet to discuss the proposed scope and cost for the repair/maintenance, and if acceptable, the COR will execute the SO authorizing the Contractor to proceed.

d. The Contractor is responsible for developing the SO to include the agreed to scope of repairs and costs and tracking the SO in the FMS. Expenditures on a SO will not exceed those agreed to in the SO. Monthly management reports shall include the status of all SOs to include total expenditures and pending work.

4. Response Priority

a. Unscheduled maintenance requirements may be of an emergency, urgent or routine nature. Services may be required outside normal duty hours and must be performed immediately to prevent loss of life, injury, loss or damage to property, or serious damage. Emergency services may also be required to eliminate or deal with hazardous conditions such as floods or power outages.

b. When an unscheduled maintenance requirement is expected to cost $750 or less, the Contractor will proceed in accordance with the priority requirements below and costs for repair will be borne by the Contractor's monthly payment for CLIN 0005 (see paragraph 2.a. above). When the expected cost of unscheduled maintenance exceeds $750, the SO will be issued using the priorities shown below.

c. The Contractor will take the necessary actions to protect life, safety, health and property based on the following priorities:

Priority 1 – Emergency response is required to correct conditions that impact life, safety and health of personnel or destruction of Government property. The order is received after normal working hours and requires a response within 2 hours, and continuous effort until completion.

Priority 2 – Emergency response is required to correct conditions that impact life, safety and health of personnel or destruction of Government property. The order is received during normal working hours and requires a response within 30 minutes and continuous effort until completion.

Priority 3 – Urgent response is required to correct conditions that do not constitute an emergency but are essential. Response is required with 8 working hours and will be completed within 5 working days or as agreed to by the COR.

Priority 4 – Routine response is required to correct conditions that do not constitute an emergency or urgent need. Response is required within 5 working days and completed within 15 working days or as agreed to by the COR.

H. Alterations and New Construction (CLIN 0007)

1. The Contractor may be required to perform minor alterations and new construction within the USACIL facility as approved by the Contracting Officer.

2. Option for alterations, modifications and new work: The Government may require the performance of work under CLIN 0007 of the bid schedule <u>at any time and on multiple occasions, as the need arises, during the 5 year O&M phase of the contract</u>. Such work will be requested by a Work Order in accordance with the O&M Statement of Work. Prices for labor, materials, and overhead for each Work Order will be negotiated using the R.S. Means Facilities Construction Cost Data Guide in effect at the time of the issuance of the Work Order, multiplied by the City Cost Index's Total Weighted Average for Atlanta, GA. Options will be executed by a bilateral modification to the contract citing this paragraph.

3. Prices for labor, materials, and overhead will be the R.S. Means Cost Estimating Guide in effect at the time of the negotiations multiplied by the Area Cost Factor for Atlanta, Georgia shown in the bid schedule. Quantities of labor and material will be negotiated. Profit will be negotiated.

4. This option may be exercised at any time after acceptance of the facility.

5. The Government reserves the right to accomplish this work by other methods including through other procurements.

I. Hours of Operation

1. Normal Hours

   a. The Contractor shall perform routine repairs and maintenance between the hours of 0730 – 1600, Monday through Friday, except for observed federal holidays.

2. Priority One Response

   a. The Contractor shall respond to Priority One Service Orders on a 24 hours per day, 7 days per week basis. The Contract Facility Manager (CFM) or a designated alternate should routinely be on site during normal duty hours, and on call during non-duty hours. If the CFM can not be on duty, a substitute shall be identified. The CFM and any resources that need to be dispatched as required to meet the situation shall answer the call. In accordance with the Staffing Plan, the Contractor shall provide the Contracting Officer

(CO) with the name and telephone number of the individual. Services calls will not be answered by an answering machine.

1.2 CONTRACTOR PERSONNEL QUALIFICATIONS, DUTIES, AND TRAINING

A. Contractor Staffing

1. The Contractor shall provide the manpower, staff, and management needed to satisfy the specified O&M requirements. These requirements will vary during the contract execution period and the Contractor shall employ adequate manpower in order to satisfy the all the varying requirements of this work description. Craft persons, such as painters, carpenters, masons, sheet metal workers, electricians, and HVAC mechanics may not be required full time, but will be needed periodically for preventive maintenance, unscheduled maintenance, and the continuous commissioning. The Contractor's plan for meeting the manpower requirements of the O&M period will be outlined in the Staffing Plan (paragraph 1.5.D). The Contract Facility Manager is a full-time requirement for a person dedicated to the USACIL O&M period management.

B. Contract Facility Manager (CFM).

1. The Contractor shall provide a CFM who shall be responsible for the performance of the O&M work. The name of this person and an alternate(s) who shall act for the Contractor when the CFM is absent shall be designated in writing to the Contracting Officer.
2. The Contractor shall provide to the Government at Notice To Proceed (NTP) plus 6 months, the name, address and business and home phone numbers of the CFM and the alternate CFM.
3. The CFM and/or any alternative designated to act for the CFM, shall have full authority (through the contract execution period) to commit the Contractor to action on matters pertaining to Contractor's administration of this contract.
4. CFM will be given a space designated for the Building Automation System (BAS). The CFM or alternate shall be available during normal duty hours within 30 minutes of notification to meet on the installation with Government personnel. After normal duty hours the CFM or designated alternate shall be available within 90 minutes except as defined in emergency situations.

C. Qualifications of the CFM.

1. Personnel designated as CFM must have, a minimum of 10 years experience in operation and maintenance or closely related field, including the supervision of a diversified work force responsible for maintenance and repair of electrical, plumbing, mechanical, and structural systems;

heating, cooling, power generation systems; and energy monitoring control systems.

2. The alternate CFM must have a minimum of 5 years comparable experience.

3. The CFM and alternate(s) must be able to read, write, speak, and understand English.

D. Duties of the CFM:

1. The CFM shall conduct overall management coordination and shall be the central point of contact with the Contracting Officer or the COR for performance of all work under this contract.

2. Monitor systems performance against desired benchmarks and proactively identify corrective actions if required.

3. Maintain Government furnished manuals and publications as part of a reference library and maintain maintenance records and files as required by the Contracting Officer.

4. Operate designated terminals of the computerized Facilities Management System (FMS) and input data into that system.

5. Prepare and submit to the Contracting Officer the reports, records and service work orders as specified herein.

6. Implement subcontracts, if required, and maintains records of those subcontracts.

7. Provide training to successor Contractor and/or Government personnel on the O&M of the facilities and the facilities' systems/equipment.

8. The Contractor shall develop and submit a plan for the Monthly reporting of work performed during the previous month as well as schedule of work to be performed during the upcoming month.

E. Professional Qualifications

1. The Contractor shall ensure that employees have all applicable current and valid professional certifications (i.e. welding certificates, electrician licenses, etc.) before starting work.

F. Contract Maintenance Personnel

1. All planned contract maintenance personnel will have the same security and screening requirements as personnel employed directly by the Contractor. A plan with the following information shall be submitted to the Contracting Officer: Full identification information for each individual and resumes of companies and personnel.

G. Approvals of Personnel

1. Employees of the Contractor shall be approved prior to occupancy of the facility.

2. The Government has the right to restrict the employment under the contract of any Contractor employee or prospective Contractor employee who is identified as a threat to the health, safety, security, general well being or operational mission of the installation and its population. No convicted felons will be allowed to work at the site.

3. The Contractor shall not employ any person who is an employee of the United States Government if the employment of that person would create a conflict of interest nor shall the Contractor employ any person who is an employee of the Department of the Army, either military or civilian, unless such person seeks and receives approval in accordance with Department of Defense Directive 5500.7-R (Standards of Conduct). In addition, the Contractor shall not employ any person who is an employee of the Department of the Army if such employment would be contrary to the policies contained in 5500.7-R.

4. The Contractor is cautioned that off duty active military personnel hired under this contract may be subject to permanent change of station (PCS), change in duty hours or deployment. Military reservists and National Guard members may be subject to recall to active duty. Their absence at any time shall not constitute an excuse for nonperformance under this contract.

H. Appearance of Personnel

1. Contractor personnel shall maintain a neat appearance and be easily recognized. This may be accomplished by wearing distinctive clothing bearing the name of the company.

I. Personnel Identification

1. Contractor personnel shall wear identification badges with a current picture, company name, employee name and description. Badges shall be numbered consecutively and each badge shall be accounted for. A list of issued badge numbers and the corresponding names shall be submitted to the Contracting Officer at contract start date and shall be updated as changes occur.

1.3 FACILITIES MANAGEMENT SYSTEM (FMS)

A. Software and Hardware requirements

1. Technical description of hardware and software requirements are outlined in Specification 15951 *Direct Digital Control for HVAC.*

2. The contractor shall purchase, install and operate the FMS and shall enter into the FMS all data required to establish records for the facilities,

systems, and equipment. Some data will be available in electronic format. The contractor shall maintain (update) that data throughout the duration of the Operation and Maintenance phase of the contract.

3. All computer hardware, software historical data and systems under this section shall remain the property of the Government.

4. The contractor shall protect the FMS data from loss and shall continuously back up all data to a storage medium protected against fire.

5. The contractor shall not install any unauthorized copies of the FMS Software.

B. Management Systems and Record Keeping

1. Management of all preventive maintenance shall be incorporated into the database, including all PM tasks with appropriate frequencies for each item listed in the Master Equipment List.

2. All management plans schedules reports and other data deriving from the development of the Management plan shall be developed and recorded in the database.

3. To enhance forecasting of requirements, all Unscheduled Maintenance, including proposal and service order management provisions, shall be incorporated into the database.

4. All accounting shall be performed in the system.

5. All cumulative historical records shall be maintained in the system.

6. All parts, supplies, and inventories used for PM and Unscheduled Maintenance shall be included in the database so as to allow inventory accounting, forecasting, and procurement efficiency.

C. Maintaining the facility system/equipment operating logs.

1. Maintaining records of past and current building inspections for needed repairs of unscheduled maintenance to include:

   a. The dates of such inspections

   b. Results of inspections

   c. Corrections required

   d. Corrections made

2. If corrections have not been made, the file shall include

   a. A schedule for completion of required work

   b. A note explaining why corrections have not been made

   c. A backlog of unscheduled maintenance requirements.

3. Generation of reports on request by the COR to include, as a minimum, work status reports (i.e., work completed, work in progress, work scheduled, work backlog, etc.); inventory status reports (i.e., supplies used for scheduled and unscheduled maintenance, etc.); cost accounting reports; and equipment history reports.

4. Records and Data - All records and data maintained in the FMS are the property of the Government and shall be made available to the COR upon request. A complete copy of all records and data shall be provided to the COR (in electronic format) upon completion or termination of this contract.

5. Contractor personnel who will operate the FMS shall have appropriate computer skills for the task assigned. The Contractor shall assure that building occupants have access to system for data query purposes only. The contractor shall conduct training of personnel to assure proficiency in assigned tasks.

6. Equipment Maintenance and Operation. The contractor will provide routine maintenance of FMS computer equipment. If FMS equipment is damaged by contractor abuse or misuse, the contractor shall be responsible for the resulting repair and/or replacement costs. The contractor shall operate the system in accordance with the manufacturer’s instructions and shall make data backups to assure continuing operations. The failure of the computer system shall not be a basis for work stoppages or claims by the contractor.

1.4 SYSTEMS OPERATION AND MAINTENANCE MANUALS (SOMM)

A. General Requirements

1. Using the Management Plan and System Operation and Maintenance Manual Templates as a guide, the Contractor shall prepare the final Systems Operation and Maintenance Manual (SOMM). See Exhibit SOW-1 for the format of the SOMM.

2. The SOMM shall be organized by building systems as defined in Chapters 2-9 in the O&M SOW.

3. The Contractor will organize each volume’s contents using the O&M Statement of Work for guidance. The Contractor shall revise all volumes, sections, chapters, etc. to provide a comprehensive and up-to-date manual incorporating actual as-built conditions and current manufacturer's data.

4. Each volume is designed to ‘stand alone’ – providing sufficient guidance and supporting material to allow a properly trained, journeyman technician to perform proper services.

5. Preparation of the SOMM shall be under the direction of an individual or organization that has demonstrated expertise and a minimum of 10 years experience in the preparation of comprehensive and complete O&M

instructions for similarly complex systems. Qualifications shall be submitted for Contracting Officer approval.

6. Comprehensive Facilities Management Plan & SOMM preparation shall be identified as activities in the construction sequence of the Progress Schedule for the construction phase of this contract.

7. Final copies of the SOMM are due to the CO no later than 60 days prior to the start of the O&M phase of the contract.

    a. Contractor shall furnish one (1) copy of the Comprehensive Facilities Management Plan & SOMM on electronic media in Microsoft Word™ format, and six (6) hard copies.

8. On the annual anniversary of the start of the O&M phase of the contract, the manuals will be updated. The Contractor shall furnish one (1) copy of the updated Comprehensive Facilities Management Plan & SOMM on electronic media in Microsoft Word™ format, and six (6) hard copies.

1.5 COMPREHENSIVE FACILITY MANAGEMENT PLAN

A. General

1. The Contractor shall prepare a Comprehensive Facilities Management Plan (CFMP) that integrates all the management activities required for the O&M phase of the contract.

B. Submittal

1. The CFMP shall be submitted in conjunction with the Systems Operation and Maintenance Manual, in accordance with submittal requirements of Specification section 01700.

C. Minimum Requirements

1. The following are the minimum components of the comprehensive management plan:

    a. Organization and Staffing Plan

    b. Security Plan

    c. Safety Program Plan

    d. Training Plan

    e. Warranty Plan

    f. Contract Maintenance Plan

    g. Continuous Commissioning Plan

    h. Preventive Maintenance Plan

    i. Quality Control Plan

D. Organization and Staffing Plan.

1. The Contractor shall prepare and maintain a written, current organizational plan. The plan shall indicate all categories of personnel employed by the Contractor and Subcontractors as listed by system and the reporting relationships established therein.

2. This plan shall be posted in an accessible location in the Government furnished space provided to the Contractor.

3. The manpower and staff needed to satisfy the specified O&M requirements will vary during the contract execution period. The Contractor shall employ adequate manpower in order to satisfy all requirements of this work description. Craft persons, such as painters, carpenters, masons, and sheet metal workers, may not be required full time, but needed periodically for unscheduled maintenance.

E. Security Plan

1. The Contractor shall develop and submit to the CO for review, a comprehensive Security Plan.

2. Security for USACIL is monitored by a centralized security system. The Government Security Manager and Safety Officer will screen and train personnel to familiarize them with the Security Control Operations.

3. The Contractor shall be responsible for safeguarding all Government property provided for Contractor use, and shall comply with the installation and/or Lab Physical Security Plan. At the close of each work period, Government facilities equipment and materials shall be secured.

4. The Contractor shall designate a security manager who works with security clearance issues and provides the appropriate information to the Government Security Manager and Safety Officer. Security clearance required for employees performing maintenance in support of CIDL:

CFM / ACFM	DA Secret
Routine / Regulars	DA Secret
Occasional	Must be escorted, clearance not required

5. Key Control

   a. The CFM shall maintain key control of keys issued to the Contractor work force.

   b. The Contractor shall establish and implement methods of ensuring that all keys issued to the Contractor by the Government are not lost or misplaced and are not used by unauthorized persons. No keys issued the Contractor by the Government shall be duplicated.

c. The Contractor shall immediately report the occurrences of a lost or duplicated key to the Contracting Officer and the Government Security Manager and Safety Officer.

d. In the event keys, other than master keys, are lost or duplicated, the Contractor shall be required, upon direction of the Contracting Officer, to re-key or replace the affected lock or locks. The Government, at its option, may replace the affected lock or locks or perform re-keying at no cost to the Government. In the event a master key is lost or duplicated, the Government shall replace all locks and keys for that system, and new keys issued to the Contractor. The total replacement cost shall be deducted from the monthly payment due to the Contractor.

e. The Contractor shall prohibit the use of keys issued by the Government by any persons other than the Contractor's employees engaged in the performance of assigned work. The Contractor shall prohibit the opening of locked areas by the Contractor's employees to permit entrance of persons other than the Contractor's employees engaged in the performance of assigned work in those areas.

f. The contractor shall establish and implement methods of ensuring that all lock combinations are not revealed to unauthorized persons. These procedures shall be included in the Contractor’s Security Plan.

F. Safety Program Plan

1. The Contractor shall develop and submit to the CO for review a comprehensive safety program describing procedures and plans for preventing accidents and for preserving the life and health of Contractor and Government personnel in any way involved with the performance of this contract. The safety program shall comply with regulations as specified by the Occupational Safety and Health Administration (OSHA).

2. The safety program section of the management plan shall, as a minimum, address responsibilities and procedures that all Contractor personnel must follow. The safety program shall address, as a minimum:

   a. Fire safety (hazard prevention, reporting, evacuation layouts, and extinguishers)

   b. Maintenance shop safety (battery shop operation, protective clothing, protective equipment, storage of oils and lubricants, disposal of waste and contaminated oil, and use of acetylene torches, electric welders, and power equipment)

   c. All other devices and procedures necessary to protect the employee.

3. The Contractor shall ensure that all employees know, receive instruction on, and comply with all appropriate safety requirements.

4. The Contractor shall prepare a plan to ensure that all hazardous material/waste used or generated by any Contractor personnel is properly inventoried, stored, handled, packaged, and disposed of in an appropriate manner. The Contractor's planned procedures for hazardous material and waste disposal shall be submitted to the Contracting Officer for review and approval 10 days prior to the assumption of the maintenance mission. The Contractor's responsibilities include:

    a. Inspecting all shops, maintenance facilities, storage areas, and other facilities under Contractor control where hazardous substances, materials, and/or wastes are either generated or stored, thereby ensuring adequate handling, generation, and storage procedures and identifying any violations of the fire code (NFPA 30, Flammable and Combustible Liquid) hazardous material/waste laws and/or regulations.

    b. Recording all violations and corrective actions taken; transporting, storing, and handling hazardous substances in a safe and environmentally acceptable manner; and instituting a responsive alert and reporting procedure for use when a spill occurs.

    c. Cooperating with Government agencies in order to ensure that the public health and welfare is adequately protected from discharge of oils and hazardous materials/waste.

    d. The general guidance for disposal of waste is as follows:

        1. Hazardous waste – Turned in to the installation designated points of reception.

        2. Non-hazardous waste – Properly placed in the dumpster assigned to USACIL.

G. Training Plan

1. The Contractor will develop a written Training Plan for approval of the Contracting Officer 60 days prior to acceptance of the facility. Training Plan shall include lesson plans/lesson outlines, expected duration of each session, who will receive the training, and frequency of instruction if training is of a recurring nature or identified as refresher training. The following types of training shall be provided to all Contractor O&M personnel performing under this contract.

2. Orientation

    a. The Contractor shall provide sufficient training for all employees performing duties under this contract. The training shall be provided as soon as practical after employees begin work. As a minimum, however, the initial orientation training shall be completed prior to the date an employee begins work. Orientation training shall include the following topics:

1. Appropriate interactions with staff.
2. Familiarization with applicable local base regulations and policies (including fire prevention, ground safety, and natural disaster plan).
3. Familiarization with technical manuals.
4. The duties of each employee.
5. The proper collection, handling, storage, transportation, and disposal of Contractor-generated waste.
6. Employee personal hygiene and appearance (Proper dress and work attire).
7. Adherence to work schedules.
8. Documentation or completion of scheduled work assignments.

3. Contract Personnel Technical Training

a. The Contractor shall provide sufficient technical training to insure the maintenance team is at an appropriate level of proficiency before performing O&M duties. Training, to include annual refresher training, shall be provided at no cost to the Government. Training shall be documented and included in the monthly management report.

H. Warranty Plan

1. Warranty plan identifies any existing equipment warranties, specifying the vendor offering the warranty, the length of the warranty, and any special O&M requirements that must be met in order to preserve the warranty.
2. A sample of the warranty schedule has been included in Appendix A, MS-3 – Warranty Information Template. A schedule shall be prepared for each system and summarized in a comprehensive schedule and located in the Comprehensive Management Plan Volume.
3. All maintenance work during the first year shall be done by or coordinated with the contractor and manufacturer holding the warranty. The personnel shall meet the minimum service requirements and/or certifications recommended for that system or piece of equipment.
4. Any warranties that have effective durations that extend beyond the combination of the construction period and the period of operation and maintenance shall be accrued to the government.

I. Contract Maintenance Plan

1. The contract maintenance plan outlines procedures and methodologies for accomplishing the maintenance of various systems and items of equipment by maintenance contracts.

2. The contract maintenance plan also includes technical specifications/statements of work for those systems and equipment to be maintained by the contractor, and a detailed cost estimate for the work described in the technical specifications.

3. If required, just-in-time or on-call contracting methods may be utilized with respect to complex systems and equipment (MEP, laboratory, security, fire alarm systems, etc.) that require special skills or certifications to maintain.

J. Continuous Commissioning Plan

1. The Contractor will demonstrate how the routine, predictable and preventive maintenance activities will integrate into a plan that achieves continuous attention to critical building systems and achieves proactive care of USACIL.

2. The Contractor will include a methodology by which performance of building systems can be benchmarked against design and manufacturer's expected performance criteria as required in paragraph 1.1.F.

3. For any systems that begin to degrade or deviate from manufacturer's expected performance criteria, the Contractor shall develop and execute remedial corrective actions to bring the system into compliance

K. Preventive Maintenance Plan

1. The Preventive Maintenance (PMP) identifies the various types/levels of preventive maintenance that will be accomplished by the maintenance staff. The plan must reflect response times/categories for the various items of equipment and identify a generic procedure for the management of service orders.

2. Scheduled maintenance requirements have been defined for each system in subsequent chapters (2-9).

3. The PMP shall identify the PM tasks and frequencies for each item listed in the Master Equipment List (MEL). This plan also identifies the skills (trades) required and man-hour estimates for performing the PM tasks.

4. Facility Systems/Equipment Assessments requirements shall be incorporated within the PMP. These shall include at a minimum:

    a. Life Safety Assessments and Tabulation - This assessment identifies life safety/fire protection code issues and stipulates corrective actions needed to meet National Fire Protection Association (NFPA) where applicable.

b. Continuous assessments will be used to compare actual building systems performance against design parameters.

c. O&M Equipment Operational Assessment - This assessment identifies systems and equipment issues, identifies corrective actions (replacement, upgrade, or renovation), and provides cost estimates.

L. Quality Control Plan

1. The Contractor shall establish and maintain a complete Quality Control Plan to ensure the requirements of the contract are provided as specified. The Quality Control Plan shall outline the process that the Contractor will use to manage the level of performance.

2. The Quality Control Plan shall include an inspection system covering all the services listed on the O&M Statement of Work. It must specify the areas to be inspected, and the individual(s) who will perform the inspection.

3. System performance benchmarking shall define methods for identifying and preventing deficiencies in the quality of service before the level of performance becomes unacceptable.

4. The Contractor shall review systems performance annually by analyzing on-site records of all inspections conducted by the Contractor and necessary corrective action taken. This documentation shall be made available to the Government during the term of the contract and used to benchmark the productivity of the maintenance effort.

1.6 O&M SUCCESSOR

A. Turnover Requirements

1. The last three months of the contract execution period shall be used for an orderly transition of responsibility to the successor that will execute the follow-on O&M program.

2. An initial meeting between the COR and the CFM for both outgoing and incoming Contractors, shall be held to address phase-out requirements and responsibilities no later than 3 months prior to the end of the current O&M phase. Subsequent meetings will be held as determined by the Contracting Officer, but not less than weekly thereafter.

3. When the incumbent Contractor is also the successor Contractor, these required meetings shall not be waived; since orderly transition form one work specification to another will also require significant management involvement in the transition process.

4. The successor Contractor shall perform all start-up procedures.

5. The successor for the follow-on O&M program may be Government personnel.

6. During the final three months of this contract, if the incumbent Contractor is not awarded the subsequent contract, the Contractor shall permit his successor and the successor's key personnel to observe and become familiar with any and all operations under this contract.

B. Successor Training.

1. The Contractor shall schedule and provide training for the new personnel that will be assuming the operation and maintenance of the facility.

2. The Contractor shall provide on-the-job training (OJT) to each of the O&M successor personnel to ensure sufficient familiarity to take over the O&M responsibilities of the USACIL.

3. Using skill levels defined by the training templates, the training objective is to enhance technical skills so that transfer of O&M responsibility for USACIL’s unique systems/equipment will be efficient.

4. Certification of training shall be provided to the CO within 3 days after the completion of training. Ceritification shall include information such as name of craftsperson trained, system trained on, type of training, number of hours trained, etc.

5. Training shall cover features unique to complex electrical and mechanical systems installed at USACIL and FMS features such as hardware and software, form and file formats, CADD, database and file management systems, and LAN functions.

1.7 GOVERNMENT PROVIDED FACILITIES AND SERVICES

A. General Requirements

1. The Government shall provide without cost to the Contractor, during the performance of the O&M portion of the contract, the facilities and services listed below:

B. Government-Furnished Facilities

1. Maintenance support space furnished to the contractor by the Government shall be in the following designated areas:

   a. Government will provide space in BMS Room #924 for the CFM and the operation of the Building Management System.

   b. The Government shall furnish the Contractor with a "shop area" for equipment and tools. The area, determined by the analysis of the mission critical repair parts and tools and equipment, shall be approximately 500 square feet of unfinished shell space.

c. Limited vehicle parking space for contractor personnel will be provided.

d. The contractor shall provide all furnishings, (except basic administrative space furnishings which will be provided by the Government in order to be compatible with furnishings in USACIL shared space), office and shop equipment, and off-post telephone service. All contractor-supplied furnishings, office equipment, and telephone service will remain the property of the contractor at the expiration or termination of this contract.

C. Government-Furnished Services

1. The Government will provide to the contractor all water, sewage, trash disposal, and electrical services required for the performance of this contract.

2. The Government will provide on-post telephone service. Government furnished telephone service shall be used only in connection with business relating to the performance of this contract.

3. Commercial telephone service acquired by the contractor for contractor use shall be paid for by the contractor.

4. Failure of the Government to furnish utilities at any time during the performance of the contract because of outages or other interruptions in service shall not be considered by the contractor as a basis for a claim against the Government.

D. Government-Furnished Fuel

1. The Government will furnish diesel fuel for emergency generators. The Contractor shall identify fuel requirements for ordering purposes. Receiving, receipting, and accounting for fuel will be the responsibility of the Government.

E. Fire and Security Police Protection

1. The Government will provide fire and security police protection services for all Contractor employees performing official duties under this contract.

1.8 GOVERNMENT QUALITY ASSURANCE (QA)

A. General Requirements

1. The Government will evaluate the Contractor's performance under this contract in accordance with the Federal Acquisition Regulation (FAR) Inspection of Services clause.

2. The Government will record all surveillance observations and inspection results. When an observation or inspection indicates deficient performance, the Contracting Officer's Representative (COR) will prepare a Deficiency Report.

B. Annual Walk Through

1. On an annual basis, concurrent with the Continuous Commissioning Program, the Contractor will accompany the Government and User on walk-through inspection of all USACIL spaces. The Contractor will document all observations and prepare a final report of the observations organized by facility system. This report will be provided to the Contracting Officer in three hard copies and one electronic copy within 10 days after completion of the walk-through.

C. Deficiency Reports (DR)

1. If the Contractor's performance is found to be unsatisfactory and not in compliance with the requirements specified in this contract, the Government will issue a Deficiency Report (DR) within 3 days.

2. Upon presentation of a DR by the Government, the Contractor shall immediately sign the DR, acknowledging its receipt. Within 3 working days of receipt of a DR, the Contractor shall explain in writing to the Government either:

   a. How performance does conform to the requirements of the contract;

   b. How performance will be returned to conformity;

   c. How reoccurrence of the problem will be prevented in the future.

D. Meetings

1. The Contractor will be required to attend Monthly reviews with COR and User.

2. Additionally, the CFM may be required to meet at least weekly with the COR during the first three months of the O&M phase of the contract.

3. The Contracting Officer may require additional meetings whenever a Deficiency Report (DR) is issued.

4. The minutes of all meetings will be prepared by the Government shall be signed by the CFM, COR, and the Contracting Officer if in attendance. Should the Contractor not concur with the minutes, the Contractor shall so state any areas of non-concurrence in writing to the Contracting Officer within 7 calendar days of receipt of the signed minutes.

5. The contractor shall prepare forms as part of the Systems Operation and Management Manual (SOMM) and in accordance with requirements of the management plans that have places for the COR to initial that the work has been in a satisfactory manner. The contractor will be required to keep a record of these completed forms in the operation and maintenance performance log.

E. Monthly Reports

1. A monthly report shall be submitted that reports all activities completed for the preceding month and projected for the upcoming month. The following will be addressed at a minimum:
2. For the month completed:
    a. Operational Issues.
    b. Preventive Maintenance completed.
    c. Continuous Commissioning of Critical Systems completed.
    d. Unscheduled Maintenance completed by task and service order (including cost) for those tasks under $750.
    e. Unscheduled Maintenance completed by task and service order (including cost) for those tasks over $750.
    f. Alterations and New Work completed including cost.
    g. Any changes to the Contract Facility Manager or supporting maintenance staff.
    h. Deficiency Reports issued.
3. For the month ahead:
    a. Preventive Maintenance scheduled.
    b. Continuous Commissioning of Critical Systems scheduled.
    c. Any other issues that require Government action too assure efficient operation of the USACIL and maintenance of the facility.
4. The report shall be presented written in an executive summary format and provided in hard three copies and one electronic copy three days prior to the scheduled monthly review.

1.9 Exhibit SOW-1 Organization of SOMM

A. General Information

1. The following paragraphs provide the guidance for the overall intent and structure for completion of the Systems Operation Maintenance Manual. Templates are included in Appendix A MP&SOMM, for completion by the Contractor. (Several sections have been initialized in Appendix A.)
2. This section introduces the specific building system and identifies sources of information.

B. Specific System Description

1. This section identifies the specific systems and/or major subsystems that comprise the critical functional areas of the building infrastructure.
2. For systems consisting of more than one unit or item of equipment, or where complexity must be explained, an illustration or flow diagram will be included. If one system interfaces with another system or subsystem, this section shall define how they interface.
3. Safety and security topics shall be covered and referenced to the operating procedures, if applicable.
4. A table of capabilities and limitations shall be prepared for the systems, if applicable. The table will include data such as gallons per minute, transfers per hour, boom capacity, rated ranges, resolution, accuracy, data-handling capability, etc. Such data shall be presented in tabular form. Additional tables shall be provided as needed to clearly illustrate the capabilities required of a given system or item of equipment that differ because of its configuration within the system. The word "differ", as used above, refers to capabilities other than normal or standard. The fact that the input, output, feedback, or control levels required are within the design specifications of the system or item of equipment is not a sufficient reason for omitting the system or item of equipment from the table.
5. Major equipment components shall be identified and located by describing each component that is significant to O&M, logistics, and safety. A tabular list of leading particulars will be included as necessary to support the descriptions of major components.

C. Theory of Operation

1. This section addresses how the specific systems and/or major subsystems function to meet the design specifications..
2. The final comprehensive manual shall contain a discussion of the theory of operation and a listing of all the functions of the system and shall show how the various facility subsystem functions are tied together to accomplish the overall system function. The description shall include an overall analysis of the principles of operation of the system equipment and

its functions, such as control interlocks, where such principles would not be obvious to a journeyman technician. Particular attention shall be paid to the interface between facility systems and other systems. The descriptions shall be sufficiently detailed to provide O&M personnel with the understanding necessary to adequately perform the system activities and to correctly interpret the results of these activities.

3. An introduction to each specific system has been made by the design team with pertinent data given for the Contractor's use.

D. Operations

1. The final comprehensive manual shall include equipment and/or system layouts as required for clarity. Information to be provided includes all piping, wiring, breakers, valves, dampers, controls, etc., complete with functional diagrams, schematics, isometrics, and data to explain the detailed operation and control of each individual piece of equipment and/or system components.

2. Layouts should show the location within the facility of controls, valves, switches, dampers, etc., by reference to site location, wing designation, floor, room number, or other clear and concise directions for locating the item.

3. Operator data may be identical to posted data and framed instructions, but will be included as part of the O&M manuals. The instructions will include:

   a. Initial adjustments and control settings.

   b. Precautions and pre-checks to be executed prior to startup of equipment and/or system, including safety devices, monitoring devices, and control sequence.

   c. Step-by-step sequential procedures for startup and normal operation checks for optimal performance. Safety precautions and instructions that should be incorporated into the operating instructions and flagged for the attention of the operator. Procedures shall include test, normal, and automatic modes.

   d. Procedures for normal and emergency shutdown of equipment and/or systems. The instructions shall include any procedures necessary for placing the equipment and/or system on standby or preparing the equipment and/or system for startup at a later time. Procedures shall include test, normal, and automatic modes.

   e. Procedures for isolating individual equipment from the system and bringing individual equipment online once the system is operating.

   f. Operational logs and records requirements.

E. Preventative Maintenance

1. Recommended procedures shall indicate preventative maintenance (i.e. lubrications, checks, adjustments, etc.) and good housekeeping practices which should be performed by operating personnel.
2. More complex maintenance procedures that would normally be performed only by trained maintenance personnel; will also be provided.
3. Schedules indicating timeframes or operating hours for initiating operator maintenance and adjustments and including manufacturer's recommended major maintenance requirements will be provided.
4. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the maintenance procedures and flagged for the attention of personnel.
5. The procedures shall include necessary operating instructions for taking equipment offline, online, and putting equipment on standby.
6. The instructions shall address all material, equipment, and system data needed to perform maintenance work and shall include, but not be limited to the following:
   a. Manufacturers' bulletins, catalogs, and descriptive data.
   b. Certified performance curves.
   c. Copies of approved test plans, including logs and records of performance acceptance test results and actual adjustments made during final acceptance and inspections.
   d. System layouts, including block, wiring, control, and isometric diagrams.
   e. Schematic items within the facility.
   f. Interrelationships with other items of the system.
7. Emergency adjustments shall be included and flagged for the operator's attention
   a. The instructions shall also include procedures for emergency repairs that could be performed by operating personnel.

F. Trouble Analysis (TA)

1. Trouble Analysis procedures for locating and correcting trouble shall be presented in a step-by-step format.
2. Repair procedures shall be keyed to a troubleshooting guide outlined in three columns with the following headings:

Trouble/Symptom	**Probable Cause(s)**	**Corrective Action**
The indication or symptom of trouble	The instructions, including test hookups, necessary to determine the cause(s)	Procedures for restoring the system to operating condition, or cross reference to where the procedure is written in SOMM

3. Information may also be in logic tree form, or in another clear tabular format with appropriate headings. Approval of the draft format must be presented before proceeding.

4. Trouble analysis shall be documented to the extent necessary to locate the faulty piece of equipment within the system.

5. The procedures shall clearly indicate a major repair activity, which should be performed only in a shop or factory, as opposed to normal repair work, which may be performed onsite or with equipment online.

6. The procedures shall also clearly indicate the limit of repair work that may be performed by Government personnel during the warranty period without voiding the warranty provisions.

7. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the repair documentation and flagged for the attention of personnel.

8. The Trouble Analysis section shall be cross-referenced to the appropriate Exhibits and other documents in the MP&SOMM.

G. Unscheduled Maintenance

1. Cross Referenced to Trouble Analysis and to applicable Exhibits, this section provides documentation on the procedures for isolation, replacement, checkout, and integration of the equipment within the system shall be provided.

2. Test, adjustment, and checkout data, required after replacement will be included.

H. Repair Parts and Special Tools and Equipment

1. Repair Parts

   a. The Contractor is to identify and provide all required repair parts. Just in time delivery shall be used where possible. Repair parts shall be stored on site, in designated areas, as defined in the O&M SOW.

   b. A complete list of repair parts and supplies shall be provided. The list shall include all parts and components of individual pieces of equipment and all parts and components of each system and shall identify such items as nomenclature of part, model number, circuit or component identification, etc.

c. Parts and supplies lists shall be included within each volume of maintenance instructions.

d. A master list of repair parts and supplies recommended and or required by contract, from each manufacturer for one year of operation, including source of supply, shall be listed with each instruction.

e. The Contractor shall list the sources of supply for all parts and supplies, including name of supplier/manufacturer, address, and telephone number.

f. If the parts and suppliers are not normally stocked locally, necessary procurement lead time shall also be a part of the listing.

I. Vendor Data and Acceptance Tests

1. Vendor Data

a. A complete set of data, provided by the equipment manufacturer, required for operation, maintenance and checkout will be included and referenced to the appropriate specification's number.

b. Data may consist of manufacturer's brochures, O&M manuals, catalogs, drawings, service bulletins, and illustrated parts lists necessary to support the O&M of the end item of equipment and assemblies. This reprinted data shall be edited as necessary to make material project specific.

2. Acceptance Tests

a. A record of all System's Acceptance Tests shall be included in this section.

b. Any pertinent information relating to problems during testing shall be noted.

J. Special Tools and Equipment List

1. The Contractor is to identify and provide all special tools and test equipment.

2. A list of all special tools and test, diagnostic measurement, and equipment for system level maintenance in this appendix.

3. For the purpose of this specification, the phrase "special tools and test, measurement, and diagnostic equipment" is used to identify all nonstandard tools and equipment designed and developed by the manufacturer and others to perform maintenance, test/calibration, diagnostic/prognostic analysis, and other acceptance testing, and successful O&M.

4. Frequency and method of calibration shall be indicated for all special tools, equipment, and test equipment items that require calibration.

Necessary standards shall be listed immediately after each item that requires calibration.

K. Warranty Information

1. The Contractor shall incorporate warranty information for each system as identified.
2. In addition to the general warranty required by the contract, the Systems Operation and Maintenance Manual shall include any specific warranties required by other sections of the Technical Specifications and other warranties normally provided with the particular piece of equipment or system.
3. Warranties that are normally provided by manufacturers and which are beyond the warranty for construction shall be specifically noted.
4. A table indicating all warranties by system to include each subsystem shall be submitted. The table shall include, but not be limited to, the following information:
   a. Specification Section
   b. System identification
   c. Subsystem or equipment identification
   d. Term of warranty
   e. Anticipated warranty inspection date with room for actual date.
   f. Problems during the warranty period. Latent defects if they present themselves.
   g. Copy of warranty or warranty data in the absence of an explicit warranty.
5. A master list of all warranties shall be included as defined under the O&M SOW.

L. Master Equipment List

1. The design A-E developed a preliminary Master Equipment List. The MEL identifies each major system, subsystem, and equipment item.
2. The Construction Contractor, by adding the required data to the MEL, shall develop the final maintenance master equipment list.
3. The Contractor, in the process of updating and completing the MEL and creating the final maintenance master equipment list, shall convert the MEL to a machine readable database, as approved by the Contracting Officer.
4. Refer to Exhibit MS-1. - MEL Template for guidance of requirements for developing a comprehensive Master Equipment List.

5. The MEL identifies each major system, subsystem, and equipment item in generation breakdown order to the purchase end item level. The completed MEL shall contain as a minimum the following information:

   a. Item nomenclature

   b. Functional characteristics

   c. Item identifier (tag number)

   d. Specification number

   e. Design/construction drawing number. (File number when available)

   f. Manufacturer's name

   g. Manufacturer's part number

   h. Manufacturer's model/serial number

6. The Contractor shall develop a projected and as-built Master Equipment List. Refer to Submittal Requirements of the Management Plan & Systems Operation and Maintenance Manual.

7. The Contractor shall develop and maintain a master O&M manual list identifying all of the equipment for which O&M manuals will be furnished under this contract.

8. The initial submittal of the O&M manual list for equipment shall be forwarded to the Contracting Officer for approval in six copies not later than 120 days after receipt of Notice to Proceed for the contract work. Review of the O&M manual list will be completed within 30 days following receipt by the Contracting Officer.

9. Following approval of the O&M manual list, this master listing shall be updated monthly to reflect equipment additions, deletions, changes and alterations.

10. The submittals shall be arranged in alphabetical order according to the type of equipment covered and by manufacturer's equipment noun name; and shall be cross referenced to the systems involved. Each data submittal shall be dated and shall show the target or actual submittal date for O&M manuals for each item of equipment. For identical pieces of equipment within one system, only one set of O&M data for that equipment item will be required.

11. The Contracting Officer reserves the right to determine whether the above specified information as furnished by the Contractor is adequate and complete and to require such additional submittals by the Contractor as necessary to insure that adequate information has been furnished to provide the satisfactory operation and maintenance of the various items of equipment and fulfill the intent of the specifications.

12. Additional submittals or re-submittals supplementing incorrect or incomplete data shall be made within 30 calendar days after receiving notice by the Contracting Officer. All cost arising from these resubmissions shall be borne by the Contractor.

13. All system MELs will be incorporated by system and combined into a comprehensive list to be included in Volume 1, Comprehensive Management Plan of Appendix A - MP&SOMM.

14. Posted Data

    a. The Contractor shall post data for equipment or systems, in addition to O&M manuals, and as required by other Technical Specifications sections.

    b. The data shall consist of as-built schematics of all wiring, controls, piping, etc., as necessary for the operation of the equipment or system, and a condensed typewritten description of the system. The data may include approved shop drawings, layout drawings, riser, and block diagrams and shall indicate all necessary interrelation with other equipment and systems.

    c. The data may be presented in 11-inch by 17-inch drawing sheets sealed with clear plastic laminate, collated and bound for clarity and convenience of locations. The framed data presentation and outline shall be acceptable to and provided at locations designated by the Contracting Officer.

    d. The data shall be provided before personnel training or performance testing acceptance for the related items of equipment or system.

15. Framed, typewritten instructions, presented in 11-inch by 17-inch sheets sealed with clear plastic laminate, collated and bound, explaining equipment or system pre-start checkout, startup, operations and shutdown procedures, safety precautions, preventive maintenance procedures, and normal operation checks for satisfactory performance of the equipment or systems shall be posted in conjunction with the posted data

16. Instructions may be presented in one or several binders for clarity and convenience of location. The instruction presentation and outline shall be acceptable to the Contracting Officer prior to posting, and shall be provided at locations designated by the Contracting Officer.

17. All instructions shall be provided before personnel training or performance testing acceptance commences for the related item of equipment or system.

M. Training Requirements

1. The A/E has developed training requirements as a guide to the Contractor.

2. The Contractor is required to present a training plan for approval. Four (4) copies of the training plans for all required formal training shall be submitted to the Contracting Officer in draft form in one submittal. The Contractor shall provide training, printed instruction material, and training aids, in accordance with the approved plan.

3. The training plan will identify the number of man-hours of instruction required for each system following the guidelines listed in the MP&SOMM templates. The training plan will also specify the proportions of the instruction time to be used for onsite classroom instruction and for onsite instruction which will be performed utilizing the installed equipment or systems.

4. All systems and subsystems requiring training of qualified personnel to properly operate and maintain those systems shall be identified. A task and skills analysis shall be documented to identify special skills required to operate and/or maintain critical, complex or specialized systems. After the skill requirements are approved, the actual training program shall be defined.

5. The Contracting Officer will review the Contractor's proposed training plan, and the Contracting Officer's approval of the plan shall be obtained by the Contractor prior to the start of any training. The Contracting Officer will require 30 days for review and approval of the plan or for disapproval and return to the Contractor for resubmission. The Contractor needs to provide sufficient float time for any necessary resubmissions to preclude possible delays to the scheduled training.

6. The Contractor will provide a draft and final training plan and schedule. The plan shall provide the following information at a minimum:

   a. Trades to be trained and skills required.

   b. Instructional methods.

   c. Materials

   d. Special training devices needed to support the program of instruction.

   e. Attendees - planned and actual

   f. A weekly outline of all scheduled training.

   g. A day-to-day schedule showing time intervals, the major and subordinate subjects to be covered in each session, with location of training.

   h. Identification and qualifications of proposed instructors.

   i. A list of reference material to be provided by the Contractor to the trainees and a list of training materials such as operation and maintenance instructions, other written and visual aids, mockups, tools, etc.

7. The MP&SOMM will be used as the primary training document for the training instructions.

8. Formal classroom and onsite training shall be provided as follows:

   a. If significant changes or modifications in the equipment or system are made during the term of the contract after instructions have been concluded, additional instruction shall be provide to acquaint the O&M personnel with the changes or modifications.

   b. The Contractor shall provide competent personnel for formal training of Government employees or others in the operation of installed equipment and systems, performance of preventive maintenance and emergency repairs, performance of scheduled maintenance checks and procedures, performance of major repairs, and in O&M data such as wiring diagrams, control sequences, location of valves and fire dampers, etc.

   c. Operator instructions provided by the Contractor shall include a description and onsite demonstration of controls and their operation, operating limitations of equipment and systems, safety devices and their function, and actual operating performance of all equipment and systems.

   d. The Contractor shall provide the classroom including all necessary items, supplies, desks, projection equipment, chairs, tables, TV equipment, etc.

9. Recording of Training Sessions

   a. The Contractor shall provide all equipment, materials, and trained personnel and shall visually and audibly record all field instruction training sessions.

   b. The Contractor shall be responsible for providing not only a "studio quality" recording system, but a professional audio-visual production coordinator/operator/editor in order to ensure a complete and usable set of training tapes.

   c. The proposed recording system shall be of one manufacturer and shall be approved by the Contracting Officer prior to its use.

10. Informal maintenance information shall be provided. General on-the-job training shall be provided by Contractor/Subcontractor/Supplier personnel knowledgeable of the materials, finishes, equipment or systems, if determined necessary the Contracting Officer, for general knowledge, equipment orientation, installation observation, etc

N. Exhibits

1. Illustrations shall be incorporated to identify schematic drawings, riser diagrams, wiring requirements, etc., as required to provide a stand-alone comprehensive O&M manual.

2. The as-built drawings are to be kept on site for reference. All changes or additional information that arise during construction and during the five year O&M period shall be recorded and kept as a part of the manual. All detailed information shall be presented in a clear, concise and comprehensive manner to fully explain the as-built conditions.

3. An index of all illustrations and data shall be developed and presented in draft and for final approval in the submittal process.

1.10 Exhibit SOW-2 Equipment Schedule

Room Number Equipment Number	Drawing Tag	Specification Number	Portable (P), Fixed (X), Bench (B), Floor (F), Table (T), or Under Counter (UC)	New or Existing	Government Furnished Government Installed	Government Furnished Contractor Installed	Contractor Furnished Contractor Installed	Item Description (Quantity in Room - Where Applicable)- Manufacturer	Quantity	Manufacturer	Model No. / Series No.
100's											
102								**CONFERENCE ROOM**			
102.1			X	N		X		Projector	1	NEC	MT1050
102.1a			X	N		X		Proj. Mnt	1	Chief	RPS1045
102.1b			X	N		X		Ceiling Mnt	1	Chief	CMA100
102.2			X	N		X		SmartBoard	1	SmartTech	SB580Pro
102.2a			X	N		X		Wall.Mnt Cab	1	SmartTech	WMCM-580
102.2b			X	N		X		Eraser	2	SmartTech	ERA-001
102.2c			X	N		X		Markers	2	SmartTech	STYF-005
102.2d			X	N		X		Cable	1	SmartTech	TBD
102.3			X	N		X		Amp	1	QSC	D-75
102.4			X	N		X		Speakers	1pr	Tannoy	Reveal
102.4a			X	N		X		Spkr. Mnt	1pr	Generic	TBD
102.5			X	N		X		VCR	1	JVC	HRS-3900
102.6			X	N		X		DVD	1	JVC	XVFA95GD
102.7			X	N		X		Switcher	1	Extron	System 7SC

8102.8			X	N		X		Video DA	1	Extron	ADA 2 300HV
102.9			X	N		X		Sat.Reciever	1	Sony	Basic
102.10.			X	N		X		Rack	2	Mid.Atl.	SRS 2
102.10a			X	N		X		Cable Guide	2	Mid.Atl.	SRCC
102.10b			X	N		X		Clmp. Shelf	3	Mid.Atl.	RC-2
102.10c			X	N		X		Blnk 1U	8	Mid.Atl.	EB1
102.10d			X	N		X		Vent 1U	2	Mid.Atl.	VTF1
102.11			X	N		X		Switcher	1	Extron	SW 4 VGAxi
102.11a			X	N		X		Rack Shelf	1	Extron	60-190-01
102.12			X	N or E	X			Computer	1	N/A	N/A
102.13			P	E	X			Vid. Conf.	1	Picturetel	970
102.14			X	N		X		Control Unit	1	Lutron	GRX-3106-A-WH
102.15			X	N		X		Scene Cont	1	Lutron	NTGRX-2B-SLWH
102.16			X	N		X		Fluor.Dim	6	Lutron	GRX-FDBI16A120
116								**TRAINING ROOM**			
116.1			X	N		X		Projector	2	NEC	MT1050
116.1a			X	N		X		Proj.Mnt	2	Chief	RPA1045
116.1b			X	N		X		Ceiling Mnt	2	Chief	CMA100
116.2			X	N			X	Screen	2	Draper	150" AccessV w/2500
116.3			X	N		X		Switch	2	Draper	LVC-S
116.4			X	N		X		Camera	2	Sony	EVI-D30
116.5			F	N			X	Floor Box	2	FSR	FL-540P-BK
116.5a			F	N		X		4g plate	2	Extron	60-301-01
116.5b			F	N		X		2 jack mic	2	Extron	70-103-01
116.5c			F	N		X		Stereo Line	2	Extron	70-092-01
116.5d			F	N		X		5 BNC	2	Extron	70-091-03
116.5e			F	N		X		15pin w/3.5	2	Extron	70-101-03
116.5f			F	N		X(for IT Data)		Dual RJ45	2	Extron	70-100-01
116.5g			F	N		X		Wall Plate	2	Crestron	TPS-IMW
116.6			X	N	X			Speakers	16	Tannoy	CMS65-15
116.7			X	N		X		Control Unit	1	Lutron	GRX-3104-A-WH

116.8			X	N		X		Control Unit	1	Lutron	GRX-3103-A-WH
116.9			X	N		X		Scene Unit	2	Lutron	NTGRX-4S-WH
116.10.			X	N		X		Part. Cont.	2	Lutron	NTGRX-4PS-WH
116.11			X	N		X		Pwr. Sup.	1	Lutron	GRX-12VDC
116.12			X	N		X		Fluor.Dim	7	Lutron	GRX-FDBI16A120
117								**AV CLOSET**			
117.1			X	N		X		Rack	1	Mid. Atl.	ERK-4024
117.1a			X	N		X		Rack Door	1	Mid. Atl.	FD-40
117.1b			X	N		X		Power Strip	1	Mid. Atl.	PD-1220J IG No
117.1c			X	N		X		Leveling Feet	1	Mid. Atl.	LF
117.1d			X	N		X		Clamp Shelf	3	Mid. Atl.	RC-2
117.1e			X	N		X		Blnk 1U	16	Mid. Atl.	EB1
117.1f			X	N		X		Blnk 2U	7	Mid. Atl.	EB2
117.1g			X	N		X		Vent 1U	2	Mid. Atl.	VTF1
117.1h			X	N		X		Fan	1	Mid. Atl.	QFP1
117.2			X	N		X		Switcher	1	Extron	CrossPoint
											128HV
117.3			X	N		X		Mixer	2	Gentner	XAP800
117.4			X	N		X		Amplifier	1	QSC	CX204V
117.5			X	N		X		Codec	1	Polycom	VP4000
117.6			X	N		X		Scan Conv	2	Extron	VSC75
117.7			X	N		X		Sat.Reciever	2	Sony	Basic
PRP.8a			P	N or E	X			Monitor	2	N/A	-
Control								**Control System for Training Room**			
CSTR.1			X	N		X		Processor	1	Crestron	Pro2
CSTR.1a			X	N		X		Volume Crd	1	"	CNXVTC-3
CSTR.2			P	N		X		Touchpanal	2	"	TPS-4500
CSTR.2a			P	N		X		Video Card	2	"	TPS-VID
CSTR.3			X	N		X		Current Sens	3	"	ST-CS
CSTR.4			X	N		X		Power Sup	2	"	CNPWS-75
CSTR.5			X	N		X		Distribution	2	"	CN-BLOCK

CSTR.6			X	N		X		Light Control	2	"	ST-LT
CSTR.7			X	N		X		Rack Kit	3	"	ST-RMK
Control								**Control System for Conference Room**			
CSCR.1			X	N		X		Processor	1	Crestron	STS-C
								w/touchpanel			
CSCR.2			X	N		X		Current Sens	1	"	ST-CS
CSCR.3			X	N		X		Light Control	1	"	ST-LT
CSCR.4			X	N		X		Volume Cont	1	"	ST-VC
SmartBoard								**Portable SmartBoard**			
PSBS.1			X	N		X		Self Contain	1	Smarttech	RPSB3000i
								Smart Board			
								System			
PSBS.2			X	N or E	X			Computer	1	N/A	-
200's											
								FIREARMS/TOOLMARKS			
204								**CORRIDOR**			
	E-16	12350					**X**	Paper Dispenser/Cutter	**1**		
205								**ARMS VAULTS**			
	E-7	11486					**X**	Pistol Lockers	1		
206								**NIBIN ROOM**			
			B	E	X			Computer + workstations	1	NIBIN	
			B	E	X			Video camera and Printer	1	Forensic Tech	
207								**AMMUNITION ROOM**			
			P	E	X			Mobile ladder	1		

			F	E	X			Reloading Station	1	Kencraft	
208								**TRAINING**			
208.1			B	E	X			Comparison Scope	1	Leitz	
208.2			B	E	X			Video Camera and Monitor	1	Hitachi	
208.3			B	E	X			Stereoscope w/ camera	1	Olympus	
209								**APP. DEV.**			
209.1			B	E	X			Stereoscope w/ camera	1	Olympus	
			B	N	X			Video Printer	1	Sony	
211								**EXAM PROCESS**			
211.1			F	E	X			Comparison Scope /w motorized table	1	Reichert	
211.2			B	E	X			Stereoscope w/ camera	1	Olympus	
211.3			B	N	X			Digital Video Camera and Monitor	1	Sony	
212								**EXAM PROCESS**			
212.1			F	E	X			Comparison Scope/w motorized	1	Reichert	
212.2			B	E	X			Stereoscope w/ camera	1	Olympus	
212.3			B	N	X			Digital Video Camera and Monitor	1	Sony	
213								**EXAM PROCESS**			
213.1			F	E	X			Comparison Scope/w motorized table	1	Reichert	
213.2			B	E	X			Stereoscope w/ camera	1	Olympus	
213.3			B	N	X			Digital Video Camera and Monitor	1	Sony	
214								**CHEMICAL PROCESS**			
214.1			F	E	X			Ultrasonic Gun Cleaner	1	L & R	LE Series
214.2			UC	E	X			Undercounter Refrigerator	1	Frostman	117EX
	V-1-4	1161 0					**X**	Fume Hood	**1**		
215								**CLEAN ROOM**			

215.1			F	E	X			Stereoscope w/ camera on boom stand	1	Olympus	
	E-16	1235 0					X	Paper Dispenser/Cutter	1		
		1235 0					X	Adjustable Table	1		
216								**STORAGE**			
	E-8	1160 0					X	Tall Metal Storage Shelving	4		
217								**TOOL ROOM**			
217.1			B	E	X			8" Grinder	1	Rockwell	23-850
217.2			B	E	X			Drill Press	1	Rockwell	62-124
217.3			F	E	X			Band Saw	1	DoAll	2013-U
217.4			F	E	X			Table saw	1	Delta	34-444
217.5			B	E	X			Milling Machine	1	Jet-16	
217.6			B	E	X			Belt Sander	1	Baldor	BM-2
217.7			B	E	X			Cut-Off Saw	1	Milwaukee	6175
217.8			B	E	X			Buffer/Polisher	1	Baldor	332B
217.9			B	E	X			Key Machines	2	Ilco & Foley Bel	
217.10			F	E	X			Mobile Tool Chest	1	RemPro	
217.11			F	E	X			Utility Tool CabineT	1	Stackon	
	8	1160 0					X	Fume Extractor Arm	2		
218								**BULLET RECOVERY**			
218.1		1148 6	X	N			X	Bullet Recovery Tank	1		
218.2			F	E	X			Portable Snail trap	1	Savage	MDL GAD
218.3			F	E	X			Cotton/waste recovery tube	1		
219								**FIRING RANGE**			
219.1		1148 6	X	N			X	Snail Trap	1	Savage	MDL IRA96
219.2		1148 6	X	N			X	Target Retrieval System	1		
219.3			P	E	X			Chronograph	1	Oehler	35P

219.4			P	E	X			Bulletproof Lexan Shield	1		
219.5			P	E	X			Firing Table	1		
300's											
307								**COLD ROOM**			
			P	2N				EVIDENCE CART	4		
305								**EXAMINERS WORK AREA: # 305**			
305.1			F	1N	x			TRASH COMPACTOR	2		
			F	1N	x			SHREDDER	2		
-	-	-	T	~~E~~	~~x~~	-	-	Microscope, stereoscope	2	Olympus	SZH
			T	N	x			Printer, BLACK & WHITE	2		
			T	N	x			Printer, COLOR	1		
								Eqiupment Islands: # 305			
305.2			B	N	x			Centrifuge, serofuge II	2	Adams	
			B	N	x			CENTRIFIUGE,SWINGING BUCKET,REFRIGIRATED	1		REFRIGRATED
			B	8N/1E	x			Centrifuges, micro	9	Eppendorf	5415C
305.3			B	N	x			Freezers, under counter	4		
305.4			B	6N/2E	x			Heat block	8	Boekel	
305.5			B	2N/2E	x			Incubators	4	Labline	
305.6			UC	N	x			Refrigerator, under counter	6	Labline	
305.7			B	E	x			Shaker Plus/Hot/Bellco	1		7746-22110
			B	N	x			UV workstation	2		
			B	N	x			Vortex	8	VWR	G-560
			B	N	x			Free Standing Filter Boxes	2	-	-
305								**Personal Lab benches: # 305**			
			B	N	x			Computer, laptop	18		

305.8			B	8N/8 E	x			Heat sterlizer	16		
305.9			UC	16N	x			UNDERCOUNTER 'FRIDGE	16		
			B	N	x			MICROSCOPE	3		
								VORTEX	16		
	HV-1-6	11610					X	Fume Hood	1		
		12350					X	Lab Table Type 3 w/ Casters	12		
		12350					X	Flexible Work Stations	16		
306								**LARGE POLYLIGHT: # 306**			
			X	N		x		Light source W/ adjustable arm	1	Polilight	
306.1			UC	N	x			UNDERCOUNTER 'FRIDGE	1		
			X	N		x		white light w/ overhead arm	1		
			B	N	x			COMPUTER	1		
			B	N	x			STEREO'SCOPE	1		
			P	N	x			DIGITAL CAMERA + tripod	1		
			B	N	x			Heat sterlizer	1		
	E-16	12350					X	Paper Dispenser/Cutter	1		
	HV-1-6	11610					X	Fume Hood	1		
		12350					X	Adjustable Table	1		
308								**LAM FLOW STATION**			
	E-6	11600					X	Laminar Flow Cabinet	1		
	V-1-4	11610					X	Fume Hood	1		
309								**CODIS ROOM: #309**			
309.1			UC	N	x			UNDERCOUNTER 'FRIDGE	1		

309.2			UC	N	x			UNDERCOUNTER FREEZER	1		
			B	N	x			COMPUTER	1		
	E-5	1160 0					**X**	6' Biological Safety Cabinet	**1**		
		1235 0					**X**	Lab Table Type 2	**4**		
310								**APPLICATION DEVELOPMENT**			
310.1			UC	N	x			UNDERCOUNTER 'FRIDGE	1		
310.2			UC	N	x			UNDERCOUNTER FREEZER	1		
			B	N	x			COMPUTER	1		
	E-5	1160 0					**X**	6' Biological Safety Cabinet	**1**		
		1235 0					**X**	Lab Table Type 2	**4**		
312								**MEDIUM POLYLIGHT: # 312**			
312.1			UC	N	x			UNDERCOUNTER 'FRIDGE			
			X	N		x		Light source W/ adjustable arm	1	Polilight	
			B	N	x			COMPUTER	1		
			X	N		x		white light w/ overhead arm	1		
			B	N	x			STEREO'SCOPE	1		
			P	N	x			DIGITAL CAMERA + tripod	1		
			B	N	x			Heat sterlizer	1		
	E-16	1235 0					**X**	Paper Dispenser/Cutter	**1**		
	HV- 1-6	1161 0					**X**	Fume Hood	**1**		
		1235 0					**X**	Adjustable Table	**1**		
313								**COLD ROOM**			

314								**STORAGE: # 314**			
314.1			F	N	x			EXPLOSION PROOF 'FRIDGE W/HOOD	1		
314.2			F	4N/1E	x			FREEZER,UPRIGHT, -20C	5		
314.3			F	E	x			FREEZER, UPRIGHT, -80C	1		
			B	N	x			COMPUTER W/BARCODE	1		
	E-10	11600					**X**	Flammable Storage Cabinet	**1**		
	E-8	11600					**X**	Tall Metal Storage Shelving	**?**		
315								**DISHWASHING REAGENT PREP.**		**#315**	
			B	E	x			Balance	2		
315.1			UC	N	x			REFRIGERATOR, UNDER COUNTER	1		
			P	N	x			CART	1		
			X	N		x		WATER POLISHER, LARGE CAP.	1		
315.2			UC	N	x			Freezer UNDERCOUNTER	1		
			UC	E	x			Microwave	1		
			B	N	x			pH meter	1		
			UC	N	x			Refrigerator UNDERCOUNTER	1		
315.3			B	N	x			ELECTROPHORESIS+POWERPACK	1		
			B	N	x			COMPUTER			
			B	E	x			LABEL PRINTER	1		
315.4	E-3	11600	X	N			X	Glassware Washer/Dryer	1		
315.5	E-1	11600	X	N			X	Small Sterilizer	1		
			B	E	x			STIRRING HOTPLATE	3		
	V-1-4	1161					**X**	Fume Hood	**1**		

		0									
317								**DNA EXTRACTION #1: # 317**			
					x			VACUUM STATION FOR SLOTS	1		
			B	N	x			Computer workstation	1		
317.1			B	N	x			CENTRIFUGE	2	Jouan	CR442
317.2			B	N	x			CENTRIFUGE	2	eppendorf	5415C
			B	N	x			Vortex	2	VWR	G-560
317.3			F	N	x			REFRIGERATOR, EXPLOS.PROOF	1	IF POSS. VENTED FOR PHENOL FUMES	
317.4			B	N	x			Incubator- Oven	1		MDL 1500
317.5			UC	N	x			UNDERCOUNTER 'FRIDGE	**1**		
317.6			UC	N	x			UNDERCOUNTER FREEZER	**1**		
			B	N	x			SHAKER, ORBITAL	2	BELLCO	
			B	N	x			PRINTER, BLACK & WHITE	1		
317.7			F	N	x			STAND ALONE FRIDGE	1		
	HV-1-6	1161 0					**X**	Fume Hood	**1**		
318			B	E	x			**X-RAY PROCESSOR: # 318**			
318.1			B	E	x			X-ray Processor- small			
319								**DNA EXTRACTION#2: # 319**			
319.1			UC	N	x			UNDERCOUNTER 'FRIDGE	2		
319.2			UC	N	x			UNDERCOUNTER FREEZER	2		

319.3			F	N	x			CHROMATOGRAPHY 'FRIDGE	1		
			B	N	x			COMPUTER WORKSTATION	1		
			B	N	x			PRINTER	1		
319.4			B	E	x			CENTRIFUGE	2	Jouan	CR442
319.5			B	1N	x			CENTRIFUGE	6	eppendorf	5417C
			B	N	x			Vortex	4	VWR	G-560
319.6			F	N	x			REFRIGERATOR, EXPLOS.PROOF	1	IF POSS. VENTED FOR PHENOL FUMES	
	HV-1-6	11610					**X**	Fume Hood	**3**		
321								**DNA AMP. # 321**			
					x			310-CE's	4	Perkin Elmer	
			P	N	x			DIGITAL CAMERA + tripod	1		CV-235
321.1			B	E	x			Micro Centrifuge-eppendorf	2	5417C	5415C
			B	N	x			Computer + workstation	1		MDL P-048
			B	N	x			PRINTER	1		
321.2			UC	N	x			UNDERCOUNTER 'FRIDGE	2		
			X	N		X		Water purification unit (POLISHER)	1	Millpore	
321.3			F	N	x			Refrigerator, CHROMATOGRAPHY	1		MDL 3751
321.4			F	N	x			FREEZER, UNDERCOUNTER	2		MDL 3750
			B		x			Thermolcyclers	4	Perkin Elmer	9700- 4
			B	N	x			Vortex	2	Sci Industries	G560
321.5			X	N		X		Sterlizer (small)	**?**		Was deleted

	E-5	1160 0					X	6' Biological Safety Cabinet	2		
322								DNA AMP. SETUP: # 322			
322.1			B	E	x			Centrifuges	2	Eppendorf	5415C
			B	N	x			Computer + workstation	1		MDL P-048
322.2			UC	N	x			Freezer, UNDERCOUNTER	2		
322.3			UC	N	x			UNDERCOUNTER 'FRIDGE	2		
			B	N	x			Vortex	2	VWR	G-560
			B	N	x			PRINTER	1		
	E-4	1160 0					X	4' Biological Safety Cabinet	3		
323								AUTOCLAVE			
					x			Benchtop Sterilizer	1		
						x		Pure Water Polisher	1		
400's											
404								T.E. EXAMINER ROOM			
404.1			B	E	X			Stereomicroscope w/ fiber optic	12		
404.2			B	E	X			Polarized Microscope	8		
404.3		O	UC	N	X			Undercounter Refrigerator	4		
		O	B	N	X			Free Standing Filter Boxes	8		
	E-16	1235 0					X	Paper Dispenser/Cutter	6		
		1235 0					X	Adjustable Table	4		
		1235 0					X	Flexible Work Stations	12		
405								EVIDENCE PREP			
					X			Evidence Cage	1		
	E-16						X	Paper Dispenser/Cutter	1		
406								MSD			

			B	E	X			HP 6890 GS/MS-tower auto samp.	1		
			B	E	X			w/ MSD ChemStation	1		
			B	E	X			Printer	1		
			UC	E	X			Rough vacuum pump	1		
406.1			B	E	X			Stereomicroscope w/ fiber optic	**1**		
			B	E	X		X	L. Table Insert 1			
	8	11600					**X**	Fume Extractor Arm	**2**		
		12350					**X**	Lab Table Type 2	**1**		
407								**ARSON PREP.**			
			F	E	X			Large Arson Oven	1		
			B	B	X			Small Arson Oven	2		
			B	E	X			Ultrasonic Bath	1		
			B	E	X			Vortexer	1		
			B	E	X			HotPlates	1		
			UC	N	X			Undercounter Refrigerator **(Add to drawing)**	1		
	V-1-4	11610					**X**	Fume Hood	**1**		
408								**STAND STOR.**			
408.1		O	F	N	X			Explosion Proof Refrigerators	**?**		
					X			UC Refrigerator	**1**		
					X			Arson Oven	**1**		
					X			Oven	**1**		
	V-1-4	11610					**X**	Fume Hood	**1**		
		12350					**X**	Lab Table Type 2	**1**		
409								**EVIDENCE COLLECTION**			
409.1			B	E	X			Stereomicroscope w/ fiber optic	**1**		

		O	B	E	X			Heat Sealers	1		
409.2		O	UC	N	X			Undercounter Refrigerator	1		
	E-16	1235 0					X	Paper Dispenser/Cutter	2		
		1235 0					X	Adjustable Table	1		
410								**COLD ROOM**			
411								**EVIDENCE COLLECTION**			
411.1			B	E	X			Stereomicroscope w/ fiber optic	1		
			B	E	X			Heat Sealers	1		
411.2		O	UC	N	X			Undercounter Refrigerator	1		
	E-16						X	Paper Dispenser/Cutter	2		
		1235 0					X	Adjustable Table	1		
418								**EVIDENCE COLLECTION**			
418.1			**B**	**E**	**X**			**Stereomicroscope w/ fiber optic**	**1**		
			B	**E**	**X**			**Heat Sealers**	**1**		
418.2		**O**	**UC**	**N**	**X**			**Undercounter Refrigerator**	**1**		
	E-16	1235 0					X	Paper Dispenser/Cutter	1		
		1235 0					X	Adjustable Table	1		
414								**WET CHEMISTRY**			
			B	E	X			Bath/Circulator	1	Neslab	RTE111
			B	E	X			Density/S.G. Meter	1	Mettler	
414.1			B	E	X			Muffle Furnace (Isotemp)	1	Fisher	MDL 550-58
414.2			B	E	X			Abbe Refractometer	1		MDL 10450
414.3		O	B	N	X			Ultrasonic Bath	1		
414.4			B	E	X			Chromatovue	1		MDL C-7.1
414.5		O	B	N	X			Centrifuge	1		
414.6			B	E	X			Annealing Oven	1		
			B	E	X			Hot Plates	3		

414.7			B	E	X			Drying Oven	1		
414.8			B	E				Vacuum Oven	1		
414.9			B	E	X			Constant Temp. Bath	1		
414.10		O	UC	N		X		UC Glasswasher	1		
414.11			B	E	X			Stereomicroscope w/ fibert optic	1		
414.12		O	F	N	X			Refrigerator-Explod. Proof	2		
414.13			B	E	X			Turner Flourometer	1	Turner	TD-700
414.14			B	E	X			Homogenizer	1		
		O	**X**	**N**		**X**		**Water polisher**	**1**		
	HV-1-6	1161 0					**X**	Fume Hood	**2**		
	8	1160 0					**X**	Fume Extractor Arm	**1**		
415			B					**GENERAL INSTRUMENTS**			
			B	E	X			HP 6890 GS/MS-tower auto samp.	**2**		
			B	E	X			w/ MSD ChemStation	**2**		
			B	E	X			Printer	**2**		
			UC	E	X			Rough vacuum pump	**2**		
			B	E	X			FTIR Nicolet 550 w/Nic Plan microscope	1	Nicolet	
			B	E	X			Data Station w/ Printer	1		
			B	E	X			Pyrolysis GC System	1		
			B	E	X			P/E 8500 GC	1		
			B	E	X			CDS Pyroprobe 1000	1		
			B	E	X			HP ColorPro Plotter	1	HP	
			B	E	X			Current tch - Volt filter	1		
			B	E	X			IBM PC/AT CPU	1	IBM	
			B	E	X			IBM Monitor / keyboard	1	IBM	
			B	E	X			IBM ProPrinter II	1	IBM	
			B	E	X			Global Switch Box	1		
			B	E	X			Nelson - Interface	1	Nelson	
			B	E	X			Rough vacuum pump	1		

			B	N	X			Hydrogen generator	2		
			B	N	X			Zero Air generator	2		
			B	E	X			HP 5890 GC	1	HP	
			B	E	X			w/ Data system & printer	1		
			B	E	X			P/E GC w/ Auto Sampler	1		
			B	E	X			w/ Data system & printer	1		
		L	B	N	X			Fiberfinder	1		
			B	E	X			Oscilloscope, Tektronic	1	Tecktonic	
			B	E	X			Desiccators (acrylic cabinet)	1		
			B	E	X			Desiccators (misc) - sev.			
			B	E	X			Stereomicroscope w/ fiber optic	1		
			B	E	X			ION SCAN	1		
	8	1160 0					X	Fume Extractor Arm	6		
	11	1161 0					X	Stainless Steel Snorkel	1		
		1235 0					X	Instrument Cart-Type 1	1		
416								**AA / ICP**			
416.1			B	E	O			P/E spectrometer	1		MDL 4100 2L
			B	E	O			Balance	1	Mettler	
			B	E	O			Vortexer	1		
			B	E	O			Ultrasonic Bath	1		
			B	E	O			Laboratory Oven	1	Thelco	
416.2		O	B	N	O			Stereomicroscope w/ fiber optic	3		
		O	X	N		X		Water polisher	1		
416.3		L	F	N	X			ICP/MS w / Laser	1		
416.4		L	F	N	X			Cooler recirculator	1		
		L	B	N	X			Chem Stattion- Computer	1		
	V-3- 4H	1161 0					X	Fume Hood	1		
	11	1161					X	Stainless Steel Snorkel	1		

		0									
		1235 0					X	Instrument Cart-Type 3	1		
417								**HPLC**			
			B	E	X			Ion Analyzer	1	Wescan	
			B	E	X			Waters-Solvent pump	1		
			B	E	X			Ultrasonic Bath	1		
417.1		O	UC	N	X			Undercounter Refrigerator	1		
			B	E	X			Constant Temp. Bath	1		
	V-3-4H	1161 0					X	Fume Hood	1		
	11	1161 0					X	Stainless Steel Snorkel	1		
		1235 0					X	Instrument Cart-Type 3	1		
424								**XRD/XRF**			
		L	F	N	X			Spectrophotometer	1	XRF	
		L	B	N	X			Plotter	1	HP 7550	
		L	B	N	X			Printer	1	Okidata	
		L	B	N	X			Printer	1	HP laserjet 4	
424.1			F	E	X			Phillips x-Ray Diffractometer	1	XRD	New(78x91x152)
424.2		O	B	N	X			Stereomicroscope w/ fiber optic	1		
		O	F	N	X			Water chiller Recirculater	1		
		1235 0					X	Instrument Cart-Type 1	1		
421								**MICROSCOPY**			
			B	E	X			Hot Stage Microscope		Mettler	
			B	E	X			Pol. Stereomicroscope	1	Olympus	
			B	E	X			Nikon Phase Microscope	1	Nikon	
421.1			B	E	X			Flourescence Stereomicroscope	1		MDL 170D

			P	E	X			Video Camera System on Cart	1		
		L	P	N	X			Digital Camera System on Cart	1		
421.2			B	E	X			Stereomicroscope w/ fiber optic	1		
			B	E	X			Microscope	1	Zeiss	MPM 866
			B	E	X			Wild Combiscope	1		
					X			Microspectrometer	**1**		
		12350					**X**	Lab Table Type 2	**2**		
		12350					**X**	Lab Table Type 4	**1**		
422(DELETE)								**MICROSCOPY (DELETE NAME)**			
422.1			B	E	X			Comparison Microscope	2		
			B	E	X			Microspectrophotometer	1		
								2 moniters, 3 power sources, micro			
								printer, CPU			
			B	E	X			GRIM-Refractive Index System	1		
								CPU, 2 monitors, micro, hot stage			
								Printer, GRIM CPU			
423								**SEM/EDX**			
423.1			F	E	X			SEM XL 30CP	1	Phillips	
			F	E	X			Water chiller Recirculator	1		
			F	E	X			Vacuum Pump	2		
		O		N	X			Stereomicroscope w/ fiber optic	1		
			F	E	X			Liquid Nitrogen Carbuoy	1		
			F	E	X			Compressor-Jun-Air	1	Jun-Air	
			P	E	X			WDX system on cart	1		

			P	E	X			EDX System (under printer table)			
420		L	F	N	X			SEM XL 30CP	1	Philips	
		L	F	N	X			Water chiller Recirculator	1		
		L	F	N	X			Vacuum Pump -	2		
		L	F	N	X			Liquid Nitrogen Carbouy	1		
420.1		L	F	N	X			Compressor	1	Jun-Air	
		L	P	N	X			EDX System (under printer table)	1		
422								**SEM/XRF Prep**			
422.1		O	B	N	X			Stereomicroscope w/ fiber optic	1		
			B	E	X			Buehler Polisher	1	Buehler	49-1650 Ecomet 111
			B	E	X			Microtome w/ control panel	1		
			B	E	X			Carver Press	1	Carver	
			B	E	X			Ultrasonic Bath	1		
425A								**TRAINING ROOM**			
425A.1			B	E	X			Stereomicroscope w/ fiber optic	2		Page 3
			B	N,E	X			Pol. Microscope	1		
			P	E	X			Traveling Stereomicroscope Stand	1		
	HV-1-6	11610					**X**	Fume Hood	**1**		
		12350					**X**	Lab Table Type 2	**2**		
425								**APP. DEVELOPMENT**			
		L	B	N	X			Super Fluid Critical Chrom. Sys. (Future)	1		
		L	B	N	X			RAMAN FTIR (Future)	1		
		L	B	N	X			LC-MS (Future)	1		
								ChemStation	1		

		L	B	N	X			Scanning Probe uTA Micro Thermal Analyser (FUTURE)	1	Future	
425.1			B	E	X			Stereomicroscope w/ fiber optic	2		
					X			File Cabinets	6		
	11	1161 0					X	Stainless Steel Snorkel	1		
		1235 0					X	Instrument Cart-Type 3	2		
		1235 0					X	Lab Table Type 3 w/ Casters	1		
419								**SEM PREP ROOM**			
419.1			B	E	X			Stereomicroscope w/ fiber optic	2		
500's											
504								**INSRUMENTS ROOM**			
	E-15	1160 0	B	N			X	Ventilation Cabinet	7		
			B	E	X			Polarized Microscope 1		Bausch & Lomb	B15411PW
			B	E	X			Microscope, stereo	7	Nikon	SMZ-1
			B	E	X			CPU (Identidex)	1	Dell	X1575DL
			B	E	X			Press Hydraulic, MINI	1	Carver	MDL 3393
			T	E	X			Polarimeter	1	Perkin Elmer	MDL 243B
			T	E	X			Spectrophotometer FTIR	1	Perkin Elmer	PE 1600
			B	E	X			Spectrophotometer, UV	1	Perkin Elmer	PE Lambda 6
			B	E	X			GC-MSD	1	Hewlett-Packard	HP 6890
			B	E	X			GC-FID-IRD	1	Hewlett-Packard	HP 5890

			B	E	X			GC-MSD	1	Hewlett-Packard	HP[6890 SERIES
			T	E	X			Dessicator Cabinet	2	Plas lab	
				E	X			Balance	2	Mettler	PC4400
			BB	E	X			Balance	1	Mettler	PM480
			B	E	X			Balance	1	Mettler	PC2000
			B	E	X			Balance	3	Mettler	PG503DR
			B	E	X			Balance	3	Mettler	PG503-S
			B	E	X			Balance	4	Sartorius	PT210
			T	E	X			Oven, Dessicating		Precision	14EG
				E	X			Security Cage Portable	1	UNK	
	8	1160 0					X	Fume Extractor Arm	8		
		1235 0					X	Instrument Cart-Type 2	9		
		1235 0					X	Flexible Work Stations	7		
505								**CONTROL SUB**			
505.1		O	UC	N	X			Refrigerator	2	Labline	EEL141CTWR1
			T	E	X			Table, Balance	1	UNK	
			T	E	X			Balance	1	Mettler	AE163
			F	E	X			Floor Safe	1		
			F	E	X			Cabinet Safe	1		
			F	E	X			File Cabinet	1		
506								**NMR**			
		L	F	N				300MHZ NMR W/Console and Cabinet	1		
507								**WET LAB**			
			B	E	X			Cleaner, Ultrasound	1	Branson	MDL 3210
			B	E	X			UV Cabinet	1	UVP	Chromato-VUE CC-10
			B	E	X			Vortex Mixer	1		K-550 G
507.1			F	E	X			Refrigerator	1	Labline	EEL141CTWR1
507.2			B	E	X			Centrifuge	1	Adams	UNK

			B	E	X			Balance	1	Mettler	PT15
		O	X	N		X		Polisher Water	1		
	HV-1-6	11610					X	Fume Hood	3		
		12350					X	Lab Table Type 3 w/ Casters	4		
508								**CLEAN UP**			
508.1		O	UC	N		X		Glassware Washer	1		
509											
			B	E	X			Evaporator Rotary Vacuum	1	Ringco	UNK
			B	E	X			Microscope, stereo	1	Bausch & Lomb	
	HV-1-6	11610					X	Fume Hood	1		
	8	11600					X	Fume Extractor Arm	1		
600's											
	601	Move to Admin List						**CHIEF'S OFFICE**			
					x			CPU	1		
					x			Monitor	1		
					x			Printer	1		

602		Move to Admin List						**QD REFERENCE LIBRARY**			
					x			CPU	1		
		o			x			Monitor	1		
		o			x			Printer	1		
602.1		o			x			Stereomicroscope w/ boom stand			
		o			x			fiber optics light source	1		
		o				x		Task Lights on track	3	Burton	
							x	Exam Light Box-Recessed in casework	1		
604		o			x			Printer	1		
	605-608/ 614-616							**EXAMINER WORK**			
					x			CPU	7		
					x			Monitor	7		
					x			Printer	7		
					x			Pc Scanner	7		
605.1					x			Stereomicroscope w/ boom stand	7		
					x			Fiber obtics	7		
							x	Exam Light Box-Recessed in casework	7		
						x		Task Lights on track	21		
611								**GEN STOR/EVIDENCE RCPT**			
					x			CPU	1		
					x			Monitor	1		

					x			Printer	1		
609								**L. Instrument**			
					x			ESDA	1		
					x			IMEDD	1		
					x			RAW -1 Ribbon Reader			
					x			RAW -1 Printer			
					x			RAW -1 CPU			
					x			RAW -1 Monitor			
					x			Keyboard (IBM)			
	E-11	1160 0					**X**	Ductless Fume Hood	**1**		
610								**D. Instrument**			
					x			Infloured JF - 140 Light Source	1		
					x			MH400 Light Source	1		
					x			SONY UP-930 Video Printer	1		
					x			Model J Infrared Light Source	1		
					x			Model J Power Converter	1		
					x			UV Light Box	1		
		1235 0					**X**	Instrument Cart-Type 1	**2**		
612								**APP. DEV.**			
		o			x			CPU	1		
		o			x			Monitor	1		
		o			x			Printer	1		
		o			x			Pc Scanner	1		
612.1		o			x			Stereomicroscope w/ boom stand	1		
		o			x			Fiber obtics	1		
							x	Exam Light Box-Recessed in casework	1		
		o				x		Task Lights on track	6	Burton	
		1235 0					**X**	Lab Table Type 2	**1**		

613								**Training**			
		o			x			CPU	1		
		o			x			Monitor	1		
		o			x			Pc Scanner	1		
613.1		o			x			Stereomicroscope w/ boom stand	1		
		o			x			Fiber obtics	1		
							x	Exam Light Box-Recessed in casework	1		
		o				x		Task Lights on track	6	Burton	
700's											
								LATENT PRINTS			
704								**EXAMINER ROOM**			
		L	B	2E/10 N	X			Scanners	12		
		O	B	N	X			PC's	12		
		O	B	N	X			Color Monitor	12	Triniton	
		L	F	N	X			Color Printer,Shared	1		
		O	X	N		X		Exam Lights W/ Tracks	4		
	E-16	1235 0					**X**	Paper Dispenser/Cutter	**4**		
		1235 0					**X**	Adjustable Table	**2**		
		1235 0					**X**	Lab Table Type 2	**2**		
		1235 0					**X**	Flexible Work Stations	**11**		
705								**TRAINING**			
			P	E	X			Student Desks	4		
			P	E	X			Student Chairs	4		

706								**AFIS/ADIPS**		
			F	E	X			Fingerprint Filing CabinetS	2		
			B	E	X			PC's	4		
			B	E	X			Color Monitor	4		
			B	E	X			scanners	4		
			B	E	X			Printers	2		
			B	E	X			Hi-Resolution Fax	1		
708								**VACUUM. METALS**			
		O	X	N	X			Exam Lights W/ Wall Mount	1		
	E-9	1160 0					**X**	Freestanding Fiberglass Sink	**1**		
709								**FOOTWEAR/TIRE EXAM**			
			P	E	X			Port. Light Table	2		
		O	X	N	X			Exam Lights W/ Wall Mount	1		
			B	E	X			PC-SLIPW/Monitor Scanner and Printer	1		
	E-13	1160 0					**X**	Freestanding Stainless Steel Sink	**1**		
710								**APPLICATIONS DEVELOPMENT**			
		O	X	N	X			Exam Lights W/ Wall Mount	1		
	E-9						**X**	Freestanding Fiberglass Sink	**1**		
711								**SUPERGLUE**			
			P	E	X			light box	1		
		O	F	3N/1 E	X			CYVAC/ Superglue Cabinet	4		
711.1		O	UC	N	X			Refridgerator UC			
	E-13	1160 0					**X**	Freestanding Stainless Steel Sink	**1**		
	HV-1-6	1161 0					**X**	Fume Hood	**1**		
712								**DUSTING LAB**			
			T	E	X			Fingerprint Powder Accumulator	1	Payton	MDLI FPA- IT

		O	X	N	X			Exam Lights W/ Wall Mount	2		
	HV-1-6	11610					X	Fume Hood	2		
713								**LIGHT LASER/ALT. LIGHT**			
713.1		L	B	E	X			Laser W/Power Supply	1		
		L	F	E	X			Water Chiller Recirculator	1		
		L	B	E	X			Crime Scope	1		
		L	P	E	X			Poli-Light	1		
		L	T	E	X			RUVIS	1		
		L	B	N	X			Color Monitor	2		
		L	P	N	X			Camera -Digital	2		
		L	B	N	X			PC's	2		
714								**CHEMICAL PROCESSING**			
714.1			F	E	X			Refridgerator	1		
714.2			F	E	X			DFO Oven	1		
714.3			F	E	X			Humidity Chamber	1		
714.4		O	UC	N		X		Glassware Washer	1		
	HV-1-6	11610					X	Fume Hood	2		
716								**EVID STORAGE**			
	E-8	11600					X	Tall Metal Shelving	3		
800's											
800								**IMAGING AND TECH. SUPPORT**			
802A								**TECH SUPPORT**			
	E-4						X	4' Biological Safety Cabinet	1		
					X			Undercounter Refrigerator	1		
804								**TECH. SUPPORTS**			
805								**COMPUTER CRIME**			
					X			Anerobic Chamber	1		
			B	E	X			Monitors	6		
			B	E	X			CPU's	8	IBM	300 PL

			B	E	X			printer	2		
			B	E	X			Scanners	2		
			B	E	X			Computers	3		
			P	E	X			Laptops	4	IBM	
		L		2E - 3N	X			Evidence Cages, Roll About			
		1235 0					X	Flexible Work Stations	6		
806								**APP. DEV. TRAINING**			
808								**VIDEO/ AUDIO ENCHANCEMENT**			
		L	T	N	X			21" computer Monitors	4		
		L	R	N	X			Trintron Color Monitors	4	Sony	
			R	E	X			B/W Monitors	2	Ikegami	
			R	E	X			Waveform	1	Tektronix	
808.1			T	E	X			Motion Video Computer	2		
			R	E	X			Deck	1	Sony	Hi 8
			R	E	X			Deck	1	Sony	TL EVT 820
			R	E	X			Video Play backs decks	4	JVC	BR_S525U
			R	E	X			VHS Deck	2	Panasonic	AG 2720 TL
			R	E	X			Pro VHS Deck	2	Panasonic	AG 1960
			R	E	X			VHS Deck	2	Panasonic	AG-W1-P
		L	R	E	X			PRO VHS Deck	1	Panasonic	AG-6200
			R	E	X			Grass Valley Grp Sync./Color Bar Generator	1		
			R	E	X			Pattern Master generator	1		
			R	E	X			Vector Scope	2	Tektronix	
			R	E	X			Prime Image HR 600 + TBC	2		
			R	E	X			Prime Image Std. TBC	2		
			R	E	X			Recorder	2	JVC	BR-S822U
			R	E	X			Beta SP recorder	1	Sony	VO9850
			R	E	X			Still Video Recorder	1	Sony	
			R	E	X			Color Video printers		Vashaw	UP-45600MD
		L	R	N	X			Avid Video System			

								Audio			
				E				Recorder/Reproducers	10	Tascam 112	
				E				Digital Equalizer	2	Yamaha	
				E				Comp/ Equalizer	2	Yamaha	
				E				Comp/limiter	2	Urie LA4	
				E				Filters	2	DAC 2048	
				E				Filters	2	DAC 320T	
				E				Filters	2	DAC	DLY4T
				E				Filters	2	DAC	DLY4T
				E				Filters	2	DAC 4096T	
				E				Filters	2	DAC	PCDF 4096
				E				Color Monitor	1	Panasonic	
				E				Parametric Equalizer	4	Orban	
			R	E				Valley PR2-A Comp/limiter	25		MDL PR2-A
			R	E				Nakamichi MR1	1		
			R	E	X			Video Deck	1	JVC	BR-S525U
808.2			R	E				Spectral Dynamics Sig. analyer	1		
			R	E	X			Electronic filter	1	Ithaco	MDL 4211
			P	E	X			DAC DOW	1		
			R	E	X			Foster Speakers	2		
			P	E	X			Lamps	2		
		L	T	1N/1E	X			Computer(Audio Controller)	2		
		L	T	N	X			Monitors	2		
			P	E	X			PCAP	1		
			P	E	X			Computer Dolch	1		
809								**DIGITAL IMAGING**			
809.1			T	E				Digital Imaging computers	6		
			T	E				Monitors	6		
			T	E				Scanners	3	HP/Leaf	

809.2			F	E				Printers	1	Fuji	
			B	E				Printers	1	Harris	
			B	1E/1L				Printer	2	Kodak	
			T	E				Polaroid	2	Polariod	MP 4
			P	E				Camera	5	Kodak	DSC 200/420/460
		1235 0					X	Lab Table Type 3 w/ Casters	6		
810								**GRAPHICS**			
811								**PASS.**			
812								**STOR/GEN.**			
813								**STOR. CHEM.**			
	E-12	1160 0					X	Safety Shelving	8		
815								**LIGHT TRAP**			
					X			Refrigerator	1		
816								**WET LAB**			
816.1			F	E	X			Film processor w/ water panel	1	Wing Lynch	
		11470					X	Safe Light	1		
		11470					X	Tray Processing Assembly	1		
		11470					X	Silver Recovery System	1		
		11470					X	Acid Neutralization Tank	2		
		11470					X	Water Control Panel	1		
								X-Ray Filter Panel			
		11470					X	Chemical Shelf	1		
817								**PRINT FILM**			
817.1			T	E	X			Color Film Processor	1	Colex	
817.2			F	E	X			Film Dryer	1		
					X			Replenishment Tanks			
		1147 0					X	Safe Light	1		
		1147 0					X	Tray Processing Assembly	1		
		1147					X	Silver Recovery System	2		

		0									
		1147 0					X	Acid Neutralization Tank	2		
		1147 0					X	Water Control Panel	1		
		1147 0					X	Chemical Shelf	1		
818								**FILM DARK ROOM**			
818.1			X	E	X			B& W Enlargers	3	Ilford	
818.2			F	E	X			B & W Print Processor	1	Ilford	
818.3			F	E	X			Silver Recovery Processing Unit	1		
818.4			B	E	X			Photographic IR Dryer	1	Ilford	
					X			Replenishment Tanks			
		1147 0					X	Safe Light	1		
		1147 0					X	Tray Processing Assembly	1		
		1147 0					X	Silver Recovery System	1		
		1147 0					X	Acid Neutralization Tank	2		
		1147 0					X	Water Control Panel	1		
		1147 0					X	Chemical Shelf	2		
820/821								**MPA LASER**			
			T	E	X			Camera, Polariod	2	Polariod	MP 4
			P	E	X			polylite	1	Polilight	MDL PL-10
			P	E	X			UV light Source	1	Fotodyne	LL2000
			P	E	X			Luma Lite	1	Payton	
			P	E				Lights	2	Smith Victor	
			P	E	X			RUVIS			
		L	P	N				Laser,Self Contained			

828								**STUDIO STOR.**			
			P	E	X			Nikon 35mm Camera /Accessories	4		
			P	E	X			Medium format camera/ Acessories	4		
828.1			P	E	X			Electric Flash system	2	Speedtron	
			P	E	X			Mannikins	3		
			P	E	X			Lowel Omni/flood light system	2		
			P	E	X			Various tripods	6		
			P	E	X			Photographic lights and stands	4		
823								**FLAT CAMERA**			
823.1			F	E	X			Ks- 7 Copy Cameras	1		
824								**FLAT CAMERA**	1		
824.1			F	E	X			KS-7 Copy Cameras	1		
825								**PHOTO EVIDENCE**			
827								**STUDIO**			
827.1		L	T	N				Polariod w/ 4 lights	4	Polariod	MP 4
		O	F	N	X			Exposure booth	1	Orbiculite	
			P	E	X			Illuminators,	4		
			P	E	X			Tripods	3		
			P	E	X			Monopods	3		
			P	E	X			Large format 4x5" Horse man cameras	3		
		O	X	N			X	Studio Rail system	1		
		L	P	N	X			Digital Camera	1		
827.2			P	E	X			Luma Light	1		
827.3		O	P	N	X			Smith Victors Lights	4		
827.4		O	F	N	X			Orbiculight	1		
827.5		O	X	N	X			Fluxlights 6 bulbs	1		
827.6		O	X	N	X			Quadlights 4 bulbs	2		
827.7		O	X	N	X			Duolights 2 bulbs	2		
827.8		O	X	N	X			Northlights 2 x 3'	1		

827.9		O	X	N	X			Northlights 1 x 2	1		
827.1		O	X	N	X			Balcar Zoomlight	1		
827.11		O	X	N	X			Prolight- Powerpack	1		
827.12		O	X	N	X			Prolight- lampheads	2		
900's											
901								**DRYING ROOM**			
		1235 0					X	Table w/ casters	1		
	E-16	1235 0					X	Paper Dispenser/Cutter	1		
					X			Drying Cabinet	2		
		1462 2					**X**	Crane	**1**		
		1235 0					**X**	Lab Table Type 2 w/ Casters	**1**		
		O	F	N	X			Drying Cabinet	2		
			P	E	X			Traveling Stereomicroscope Stand	1		
903								**BULK EVIDENCE**			
		1445 0					X	Vehicle Lift	1		
		1235 0					X	Table w/ casters	1		
	E-16	1235 0					X	Paper Dispenser/Cutter	1		
		1235 0					**X**	Lab Table Type 2 w/ Casters	**1**		
904								**PROCESSING**			
		1160 0					X	Roller Table	1		
		1235 0					X	Lab Tables	5		
		1235 0					X	Work Stations	6		
		1235					X	Paper Dispenser/Cutter	5		

		0									
		1235 0					X	Flexible Work Stations	6		
905								**COLD STORAGE ROOM**			
	E-8	1160 0					X	Tall Metal Storage Shelving	8		
					X			Freezers	2		
906								**INBOUND VAULT**			
	E-8	1160 0					X	Tall Metal Storage Shelving	11		
					X			Safe	1		
908								**OUTBOUND VAULT**			
	E-8						X	Tall Metal Storage Shelving	4		
909								**HIGH DENSITY STORAGE**			
		1067 2					X	Mobile Storage Units	19		
913								**GENERAL OFFICE**			
	E-8	1160 0					X	Bulk Storage Shelving	31		
914								**SECURE STORAGE**			
	E-8	1160 0					X	Bulk Storage Shelving	6		
925								**STORAGE**			
	E-10	1160 0					X	Flammable Storage Cabinets	2		
					X			Explosion Proof Refrigerators	2		
								Polypropylene Shelving	???		
926								**FLAMMABLE STORAGE**			
	E-10	1160 0					X	Flammable Storage Cabinets	4		
					X			Explosion Proof Refrigerators	4		
927								**LOGISTICS**			
		1160 0					X	Spill Deck	1		

	E-2	1160 0					X	Medium Sterilizer	1		
					X			Explosion Proof Refrigerators	1		
								LOADING DOCK			
							X	Scissors Lift	**1**		

CHAPTER

2

VOLUME 7 OPERATION AND MAINTENANCE REQUIREMENTS

Operation and Maintenance Statement of Work

Site Systems

Table of Contents

2.0 Site Systems - General Information

A. General Description

1. The O&M Statement of Work is intended to outline the preventive maintenance for each System and their respective subsystems contained in the building. It is intended to be the continuation of the development of a comprehensive operation and maintenance program description that began during design and will be further defined during construction with the completion of the Management Plan & Systems Operation Maintenance Manual.
2. All information contained within this volume shall be performed under the Operation and Maintenance phase of this contract.
3. As more detailed information is obtained during construction with submittal approval and detailed management procedures, the manual will evolve to a detailed and specific scope of work. Information will be further developed and updated in the Management Plan & Systems Operation and Maintenance manual during the five years following construction completion.
4. This chapter is not intended to replace other contract documents, shop drawings, as-built drawings, or equipment manufacturers' instructions; instead, the intent is to supplement such documents and provide a guide to the specific scope of work required by system and equipment. It is intended to augment the understanding of the functioning of each system.
5. The periodic maintenance schedule outlined in this section represents the minimal essential preventive maintenance actions.
    a. The Contractor should consult Manufacturer's documentation for each specific item to supplement this information.
    b. In cases where Manufacturer's data conflicts with the periodic maintenance data in this chapter, the Contractor should follow the Manufacturer's recommendations and update this manual to reflect those changes.

B. Related Information

1. Chapter 1 of this manual details the management systems and defines additional scope required that will facilitate the execution of this comprehensive program. For information linking this section into the overall operation and maintenance program see the following related sections.
    a. VOLUME 7 - Operation and Maintenance Statement of Work (O&M SOW)

b. Appendix A – Management Plan & Systems Operation and Maintenance Manual Templates

c. Drawings and Specifications, especially Specification Section 01700, Operation and Maintenance Data

d. Equipment Manufacturers' Instructions

2. Refer to Electrical Systems Chapter for site electrical and communications information.

C. General Scope of Work

1. The Contractor shall be responsible for the operation, PM, and testing of all site structures in accordance with manufacturers' O&M instructions and applicable NFPA Standards.

D. General Work Practices

1. At the outset of all maintenance described herein, the servicing contractor shall follow appropriate accepted practices and applicable codes (e.g. NFPA, OSHA, etc.) for maintenance personnel protection.

2. Servicing Contractors shall utilize appropriate means, methods, and instruments for servicing all equipment listed herein; e.g., contractor shall verify the use of proper/approved system lubricant, application method, and application quantity. Procurement of said instruments shall be the responsibility of the Service Contractor.

3. All preventive maintenance work listed in this document (either written or implied) shall be performed as to not void any equipment warranties of this facility. All maintenance data listed for each piece of mechanical equipment shall be done, in their entirety, at dates of coinciding maintenance requirements, i.e. monthly maintenance shall not be foregone during times of semi-annual maintenance.

2.1 Erosion Control System

A. Quarterly

1. Contractor will check all water sources quarterly for erosion and any other areas defined within the limits of construction where surface water has concentrated and caused soil erosion. Contractor is to fill any eroded area with topsoil and seeding IAW basic contract requirements.

2. The contractor shall forward a written report of inspection to the CO as part of the routine quarterly progress meeting.

2.2 Storm Drainage System

A. Bi-Annually

1. Contractor shall inspect all yard grate inlets and curb inlets for sediment debris contained within the limits of construction.

2. Contractor shall inspect all storm drainage manholes and inlet structures for sediment and debris.

3. Contractor shall inspect the storm drainage pipes. Contractor shall also check for any pipe separation inside the drainage structure, applying mortar as needed around the pipes to seal the pipe on the inside of the drainage structure.

4. Contractor shall use a snake to route out all down spouts piping from the clean out.

5. Contractor shall remove sediment and debris from the storm drainage system and dispose of appropriately off-site.

6. The contractor shall forward a written report of inspection within ten days from the time of inspection.

2.3 Sanitary Sewer System

A. Annually

1. Inspect the Sanitary Sewer System annually.

2. Contractor is to inspect all sanitary sewer manholes to insure proper flow through the manhole. Contractor is to remove and dispose of any debris in the manholes.

3. Contractor is to notify the contracting officer of any corrections required that would disrupt the service system.

4. Contractor is required to flush the sanitary sewer manholes and service lines annually.

5. The contractor shall forward a written report of inspection within ten days from the time of inspection.

2.4 Domestic Water Distribution System

A. Contractor shall maintain the domestic water distribution system and assure that it is in an operational condition at all times. Contractor shall notify the CO of any maintenance that will disrupt the system.

B. Annually

1. Inspect the domestic water distribution annually.

2. Open and shut gate valves to insure they are in operating condition.

3. Check static and residual water pressure and flow rate.

4. Take one water sample and have an independent laboratory test the water.

5. The Contractor shall forward a written report of inspection within ten days of time of inspection.

2.5 Fire Distribution System

A. Contractor shall maintain the fire water distribution system and assure that it is in an operational condition at all times. Contractor shall notify the CO of any maintenance that will disrupt the system.

B. Annually

1. Inspect the fire water distribution system annually.
2. Open and shut all gate valves to insure they are in operating condition.
3. Contractor shall annually have an independent laboratory test all fire hydrants per NFPA Chapter 24 requirements.
4. The Contractor shall forward a written report of inspection within ten days from the time of inspection.

2.6 Site Lighting

A. Exterior Lighting (Parking Lot and Walkway Lighting)

1. Annually
    a. Perform visual inspections for burnt out or low luster lamps, physical damage, etc. and make repairs accordingly.
2. Daily
    a. Testing of the site lighting is an ongoing event through daily usage and observations. Replace or repair following established priority.

2.7 Site Communications/Electrical

A. Quarterly

1. Electrical manholes shall be inspected quarterly to ensure manholes are not full of water.
2. Contractor shall pump out all excess water and clean debris from manhole interior.

2.8 Natural Gas System

A. Annually

1. Inspect the condition of the main valves and meters
2. Report any issues immediately to the gas company, and to the COR.

2.9 Irrigation System

A. Monthly

1. Review physical operation between April and October
    a. Confirm that power failure has not affected the clock relative to schedule and sequence

b. Manually initiate all zones and check each for: damaged or missing heads, clogged or obstructed heads. Repair or replace as required.

c. Pop up heads that are stuck in the up position. When found, manually lower them and cycle the zone while observing the heads for correct operation and area of cover. If area of cover is either excessive or insufficient, adjust heads accordingly.

B. Seasonal maintenance and operation requirements

1. In autumn of each year, assure that the zone and delivery lines are empty to prevent freezing during severe cold weather.

2. In spring of each year, reactivate each zone and physically observe the function of all heads for proper function and coverage.

2.10 Concrete Flatwork

A. Inspect all concrete flat work quarterly for the following conditions:

1. Identify and mark on the plans all cracks that appear in the concrete flatwork.

2. Evaluate any changes in the cracking relative to length and width of the cracks

a. If the cracks are expanding in length and width evaluate any appearance of differential settlement. If the differential settlement occurs and exceeds 1/8th of an inch vertically make a recommendation for removal and replacement. Evaluate the cause of the settlement i.e.: inappropriate base material, inadequate compaction or drainage related damage. Recommend appropriate corrective measures for the cause as a part of the demolition and repair.

1. Removal and replacement should be done to the closest expansion joint/control join. Following demolition initiate any repairs using the materials and finishes indicated in the drawings and specifications.

3. Observe the condition of all expansion joints relative to backer rod and calking condition.

a. Confirm that all calking forms a consistent seal against water infiltration and damage. When the calk seal is found to be deficient, remove the calk and backer rod for the full distance of the joint and replace according to the drawings and specifications

4. Evaluate the concrete flat work for areas of standing water. If standing water is identified, evaluate the area for compliance with the grading and drainage plans and specifications by comparing design documents with as-built drawings or have new elevations shot of the area in question using the same benchmark as the existing conditions survey and compare the as-

built information with the grading and drainage plans. Once the cause of standing water has been determined, make a recommendation for demolition and replacement to the CO. Once approval has been given for the repairs, follow the same procedures outlined in the Section 2.10.2.a. for removal and repair to concrete flatwork.

B. Observe the condition of the concrete relative to dirt and stains. Annually in the spring have the concrete flatwork cleaned with a pressure washer and the appropriate detergents. Submit several recommended dates for CO review and approval.

2.11 Masonry Flatwork

A. Observe condition of masonry pavement relative to:

1. Standing water or loose bricks: If standing water is observed following a rain event or if loose bricks are identified, delineate the area on the pavement with a water soluble marking material. Evaluate if the situation can be corrected by removal and resetting the brick. If the repair requires demolition and replacement of concrete flatwork, follow recommended procedures in Section 2.10. Make a recommendation for repair and submit a calendar of dates for review and approval to the CO.
2. Refer to Section 2.10.3.a. for expansion joint inspection and repair procedures
3. Refer to the architectural masonry maintenance procedure for additional recommendations.

2.12 Concrete Walls

A. Evaluate the structural condition of concrete walls quarterly. Note and mark on a site plan where cracking is occurring. Note the change in any cracking over a six month period relative to length and width. If a crack expands to a width of greater than 1/8th of an inch, request the CO to have a geotechnical engineer to evaluate the condition, the cause and make a recommendation for correction.

B. Note any cracks and recommend a schedule for repairs to the CO for approval

2.13 Bituminous Pavement

A. The site consists of three parking lot areas and one drop off area in front of the building that will be the contractor's responsibility for maintenance. Contractor shall perform the following inspections.

B. In the third year of the O&M phase of the contract

1. Contractor is to add asphalt sealant to all parking lots and re-stripe all parking lots.

C. Annually

1. Contractor is to inspect bituminous pavement annually for cracks and deteriorations of asphalt. Contractor will seal all cracks with the appropriate sealant and repair damage pavement as required.

2.14 Concrete Curb and Gutter

A. Contractor shall be responsible for maintaining the concrete curbs and gutters within the parking lots and the interior curbs and gutters leading into the USACIL. (The installation will handle all the surface roads surrounding the lab.) Contractor shall perform the following inspections.

B. Annually

1. Contractor is to inspect all onsite curbs and gutters annually for cracks and damage. Contractor shall seal all cracks with appropriate sealant compound and replace any damaged curbs and gutters. Contractor is to saw cut and remove damaged curbs and gutters. Contractor is to form and pour new curbs and gutters in place of damaged curbs and gutters.

2.15 Wood Fencing

A. Contractor shall be responsible for maintaining the wood fencing surrounding the sanitation dumpers. Contractor shall perform the following inspections.

B. Annually

1. Contractor is to clean wooden fencing and re-stain each year. Use approved Wood Stain/Preservatives.

C. Semiannually

1. Contractor is to inspect wooden fence semiannually for damage and any boards that have pulled away from their supports. Contractor is to replace all damaged boards. Contractor is to repair all boards and hardware that is associated with materials which have structurally separated.

2.16 PVC Coated Chain Link Fence

A. Contractor shall be responsible for maintaining the chain link fencing surrounding the utility yard. Contractor shall perform the following inspections.

B. Bi-Annually

1. Contractor is to inspect chain link fencing for damage. Contractor is to repair/replace any damaged fencing. If the fence cannot be repaired in an acceptable manner, the contractor must replace the damaged sections of fence. All new fencing must be of the same quality as existing.

2.17 Site Signage

A. Site signage consists of all exterior signage on the site. Contractor shall be responsible for maintaining all exterior site signage. Contractor shall perform the following inspections.

B. Annually

1. Contractor is to inspect all exterior signage for damage. Contractor is to replace all damaged elements of the signs. All replacement signage must be of the same quality as existing.

2.18 Concrete Pavement

A. Concrete pavement will consist of all the concrete pavement to the rear of the building. Contractor shall be responsible for maintaining this pavement. Contractor shall perform the following inspections.

B. Annually

1. Contractor is to inspect all concrete joint fillers annually. Contractor is to repair/replace joint fillers as needed.
2. Contractor is to inspect all concrete pavement for cracks. Contractor is to clean and fill all cracks with joint fillers.

CHAPTER 3

VOLUME 7 OPERATION AND MAINTENANCE REQUIREMENTS

Operation and Maintenance Statement of Work

Architectural Systems

Table of Contents

3.0 Architectural Systems General Information

A. General Description

1. The O&M Statement of Work is intended to outline the preventive maintenance for each System and their respective subsystems contained in the building. It is intended to be the continuation of the development of a comprehensive operation and maintenance program description that began during design and will be further defined during construction with the completion of the Management Plan & Systems Operation Maintenance Manual.

2. All information contained within this volume shall be performed under the Operation and Maintenance phase of this contract.

3. As more detailed information is obtained during construction with submittal approval and detailed management procedures, the manual will evolve to a detailed and specific scope of work. Information will be further developed and updated in the Management Plan & Systems Operation and Maintenance Manual during the five years following construction completion.

4. This chapter is not intended to replace other contract documents, shop drawings, as-built drawings, or equipment manufacturers' instructions; instead, the intent is to supplement such documents and provide a guide to the specific scope of work required by system and equipment. It is intended to augment the understanding of the functioning of each system.

5. The periodic maintenance schedule outlined in this section represents the minimal essential preventive maintenance actions.

   a. The Contractor should consult Manufacturer's documentation for each specific item to supplement this information.

   b. In cases where Manufacturer's data conflicts with the periodic maintenance data in this chapter, the Contractor should follow the Manufacturer's recommendations and update this manual to reflect those changes.

B. Related Information

1. Chapter 1 of this manual details the management systems and defines additional scope required that will facilitate the execution of this comprehensive program. For information linking this section into the overall operation and maintenance program see the following related sections.

   a. VOLUME 7 - Operation and Maintenance Statement of Work (O&M SOW)

b. Appendix A – Management Plan & Systems Operation and Maintenance Manual Templates

c. Drawings and Specifications, especially Specification Section 01700, Operation and Maintenance Data

d. Equipment Manufacturers' Instructions

C. General Scope of Work

1. The Contractor shall be responsible for the operation, PM, and testing of all building systems in accordance with manufacturers' O&M instructions and applicable NFPA Standards.

D. General Work Practices

1. At the outset of all maintenance described herein, the servicing contractor shall follow appropriate accepted practices and applicable codes (e.g. NFPA, OSHA, etc.) for maintenance personnel protection.

2. Servicing Contractors shall utilize appropriate means, methods, and instruments for servicing all equipment listed herein; e.g., contractor shall verify the use of proper/approved system lubricant, application method, and application quantity. Procurement of said instruments shall be the responsibility of the Service Contractor.

3. All preventive maintenance work listed in this document (either written or implied) shall be performed as to not void any equipment warranties of this facility. All maintenance data listed for each piece of mechanical equipment shall be done, in their entirety, at dates of coinciding maintenance requirements, i.e. monthly maintenance shall not be foregone during times of semi-annual maintenance.

3.1 Masonry Wall Systems

A. In the fourth year of the O&M phase of the contract, a minimal low pressure cleaning is required.

B. Annually

1. Clean the efflorescence, mold and mildew, as needed. Inspect the face brick each year for open mortar joints, cracks in brick, efflorescence and accumulation of mold or mildew.

2. Remove any vegetation, which is attaching itself to the building each year.

3. Re-point open joints as needed after a yearly inspection.

4. Inspect building face each year and investigate any structural cracks in the brick. Do remedial work as necessary to repair and replace cracked bricks.

3.2 Metal Composite Panel System

A. Annually

1. Inspect the panels yearly for any signs of delamination for minor damage.
2. Notify manufacture immediately of any panel delamination, for manufacturer to repair or replace.
3. Repair nicks or minor damage to surface with touch up materials as recommended by manufacturer.
4. Inspect the system to verify that the weep system is still functioning as designed after each sealant repair job.
5. Clean the panels every year with water and a mild detergent as recommended by the manufacturer.
6. Inspect the sealant under that section and replace as directed in that section.
7. Inspect the fasteners when the sealant is replaced. Replace corroded fasteners and repair any damage caused by the corrosion.

3.3 Exterior Finish System

A. In the fourth year of the O&M phase of the contract, recoat exterior finish.

B. Annually

1. Inspect for cracking, flaking, peeling, blistering, crazing erosion, delamination, signs of water penetration and signs of mildew or fungus growth.
2. Notify material manufacturer or warranty carrier of unusual performance problems of accelerated weathering, unacceptable levels of resistance or water penetration, which may possibly be material related.
3. Determine cause of cracking, flaking, peeling, blistering, crazing erosion, delamination, mildew or water penetration. Repair the cause and repair the exterior finish system as required.

3.4 Corner Guards

A. Annually

1. Check for secure attachment to walls, and repair as needed. Replace missing fasteners as required.
2. Check for corrosion and repair as required.
3. Replace corner guards that are damaged beyond repair.

3.5 Expansion Joint Covers

A. Annually

1. Inspect expansion joint covers and secure all loose components as required.
2. Check for leaks and repair as required.
3. Check flexible seals for premature deterioration and notify manufacturer if seals must be replaced.
4. Clean metal surfaces as needed to restore to original finish.

3.6 Handrails and Guardrails

A. In the fourth year of the O&M phase of the contract, repaint metal surfaces. (Reference Paint Systems section)

B. Annually

1. Verify that handrails are sturdy and secured to substrate and to connectors. Tighten fasteners as required.
2. Inspect for signs of corrosion and repair as necessary. Paint if required. (Reference Paint Systems section)

3.7 Guard Posts

A. Annually

1. Verify that bollards are sturdy and secure to concrete foundation. Replace bollards that have been severely damaged.
2. Replace bollards that are dented or bent beyond repair.
3. Paint steel bollards at least annually, or sooner if required.

3.8 Safety Nosings

A. Annually

1. Verify that stair nosing is secure to each step.
2. Check abrasive strips for signs of deterioration. Replace strips that are more than 50 percent worn.

3.9 Metal Roof Systems

A. Annually

1. Inspect the metal roofing system after every major storm, hail, excessive wind or natural disaster. Remove debris from roofing. Repair or replace damaged areas using appropriate funding categories of unscheduled maintenance.
2. Inspect the roof yearly for structural deflection, movement, corrosion, standing water, system deterioration, cracking, chalking, peeling,

delamination, blistering, loss of adhesion of coating and loss of pollution resistance. Inspect all fasteners and connectors for positive anchorage.

3. Notify the roofing contractor of any warranted defects or systems failure, including water leaks and wind uplift damage. Provide intermediate repairs when approved by the roofing contractor.

4. Investigate any structural damage and remedy. Promptly remove standing water and repair areas to prevent further occurrence. Tighten all loose fasteners and connectors. Replace fasteners or connectors that are corroding and replace all deteriorated gaskets.

5. Replace sealants affected by the remedial work.

6. Investigate reported leaks and notify roofing contractor for immediate action to prevent further damage.

3.10 Membrane Roof Systems

A. In the fourth year of the O&M phase of the contract, recoat the flashing system per manufacturer's recommendations to maintain warranty.

B. Annually

1. Inspect the membrane roof systems after every major storm or natural disaster. Repair damaged areas to maintain the manufacturer's warranty. Document all inspections and repairs. For natural disasters use appropriate funding category for unscheduled maintenance.

2. Inspect the roof systems for signs of water leaks, blisters, defected membranes, flashing, and insulation.

3. Notify the manufacturer when defects in any part of the system are found.

4. Inspect the roof and remedy clogged drains, fallen objects, exposure to contaminates, expansion damage, material storage on roof, debris collection and miscellaneous damage. Yearly inspection should report any structural deflection or unusual expansion.

5. Repair miscellaneous damage to the roof systems when authorized by the manufacturer.

6. Inspect and refill all pitch pans that have deteriorated.

7. Inspect the roof appurtenances and roof top equipment for damage caused to the roof. Repair as necessary to prevent water infiltration into the roofing system.

8. Investigate reported leaks and take immediate appropriate action to prevent further damage.

3.11 Flashing and Sheet Metal Systems

A. In the fourth year of the O&M phase of the contract, clean metals with a mild detergent and water as recommended by the manufacturer.

B. Annually

1. Inspect pre-finished aluminum flashing and sheet metal work, including gutters, downspouts, scuppers, gravel stops, copings, metal flashing and counter-flashing.
2. Inspect the finish, fasteners, material composition, exposure to corrosives, runoff or metallic interaction and terminations. Verify that positive drainage is occurring. Remove debris from metals, especially at the joints.
3. Notify manufacturer if metals have faded, chalked, peeled, checked, cracked or lost integrity for warranty repairs or replacement.
4. Make necessary repairs at fasteners to make watertight.
5. Remedy corrosive exposure, runoff or metallic interactions when noted.
6. Inspect the metals after natural disasters for impact and expansion damage. Replace or repair damaged pieces with matching components, using appropriate funding categories for unscheduled maintenance.

3.12 Joint Sealants and Fire Stopping

A. Annually

1. Inspect the fire-stopping for signs of damage. Replace and restore areas that are deteriorated or disturbed to maintain fire integrity.
2. Inspect sealants for loss of flexibility (cohesion or adhesion), poor weathering, chalking, discoloration, alligator cracking, wrinkling, erosion, excessive softening, tackiness, fluidity, elongation, and elasticity. Check joints for failure from moisture penetration and verify that no staining is occurring to adjoining materials. Notify manufacturer of problem areas.
3. Wash exterior joint sealants that have accumulated dirt.

3.13 Hinged Doors and Frames

A. Annually

1. Check doors for proper closure.
2. Check condition of weatherstripping, air seals and sound seals.
3. Check that frames are secured to walls without movement. Tighten exposed fasteners, when applicable.
4. Check condition of paint. Paint doors and frames as required.

3.14 Sliding Doors and Frames

A. Annually

1. Check doors for proper closure. Adjust hardware as required under this section.
2. Check power operators and activation devices for proper function.
3. Check safety devices for proper function.
4. Check that frames are secured to walls without movement. Tighten exposed fasteners, when applicable.
5. Check condition of prefinished components and repair scratches as required.
6. Check tracks, carriers, and all moving parts for wear, and report findings to manufacturer for warranted repairs.

3.15 Overhead Coiling Doors, Grilles, and Operators

A. Annually

1. Check doors for proper closure. Adjust hardware as required. (Reference Door Hardware section)
2. Check power operators and activation devices for proper function.
3. Check safety devices for proper function.
4. Check that frames are secured to walls without movement. Tighten exposed fasteners, when applicable.
5. Check condition of prefinished components and repair scratches as required.
6. Check tracks, carriers, and all moving parts for wear, and report findings to manufacturer for warranted repairs.
7. Check weather seals and repair damaged components.

3.16 Fire Doors and Frames

A. Annually

1. Check doors for proper closure. Adjust hardware as needed. (Reference Door Hardware section)
2. Check condition of smoke and fire seals. Replace damaged components. (Reference Door Hardware section)
3. Check that frames are secured to walls without movement. Tighten exposed fasteners, when applicable.
4. Check fire rated glass is secure in frame.

5. Check condition of paint. Paint doors and frames. (Reference Paint Systems section)

6. Verify that electronic hardware functions properly. Repair and adjust. (Reference Chapter 4 – Security Systems)

3.17 Vault Doors

A. Annually

1. The vault doors are designed for little or no maintenance.

2. Check the bolts and apply a light coat of lubricant if necessary.

3. Check for obvious visible signs of tampering and report to CO.

3.18 Revolving Doors

A. Annually

1. Check that resilient seals are in place and in good condition.

2. Check that hardware and trim such as handrails, breakaway hardware, and handles are secure. Tighten as required.

3. Check that inner cylinder rotates smoothly. Clean out bottom track of dirt and debris as needed.

3.19 Door Hardware

A. Annually

1. Door hardware should be checked on an annual basis to verify proper function, loose parts, loose fasteners, damage to finish, and worn components.

2. Tighten all loose fasteners on hinges, exit devices, closers, locks, and architectural trim.

3. Verify that doors open and close properly and that doors positively latch when activated by an automatic closer, or when manually closed using normal forces.

4. Check closers for leaks and smooth closure as originally intended. Check door spring, control rate, and the arm and adjust as required.

5. Adjust locks and strikes when necessary for proper door closure and latching.

6. Check pins on hinges and set as needed.

7. Check electrified hardware, especially transfer hinges for secure and undamaged wiring.

8. Check lever handles and adjust, repair, or replace handles that are not parallel to the floor when in the closed position.

9. Check flush bolts, especially automatic flush bolts on fire rated doors for proper function. Adjust as necessary.
10. Check exit devices for proper function. Verify that vertical rod exit devices latch top and bottom as necessary. Clean out dustproof strikes if needed.
11. Verify that all electrified hardware, including locks, strikes, magnetic locks, and card readers function properly.
12. Check finish on operating trim and protective trim such as push plates, door pulls, and kick plates. Replace units when the finish cannot be restored.
13. Check floor and wall stops, and door silencers and replace as required. Check overhead stops and holders and adjust or repair as necessary.
14. Check door gasketing for proper function and wear. Tighten loose fasteners and replace worn components. Check and adjust door bottom gasketing.
15. Check door thresholds for wear and signs of corrosion. Repair or replace as necessary.

3.20 Glazed Curtain Wall System

1. During the fourth year of the O&M phase of the contract, field check for water leakage in test areas as described in AAMA 501.

B. Bi-Annually

1. Clean all the aluminum per manufacturer guidance.

C. Annually

1. Visually inspect the curtain wall system to verify that the internal drainage is working and the gaskets are sealed and continuous. Check for scratches in the finish, for air infiltration, water penetration and deflection from imposed loads. Check for any indications of staining, bleeding or corrosion.
2. Make all repairs necessary to provide water and air tight system. Repair scratches with factory provided paint.
3. Investigate the cause of any observed deflection. Repair the cause and straighten the frame.
4. If staining, corrosion or bleeding has occurred, find the source and replace the corroded components.

3.21 Laminated and Insulating Glass

A. Annually

1. Inspect for signs of dust, fog or film formation on the internal glass surfaces caused by the failure of the hermetic seal due to defects in material or workmanship. Notify the manufacturer if failure has occurred to replace the components.

2. Check glass for fractures or breakage. Replace as necessary.

3. Verify that water is not collecting in the glazing channel and that the weep system is functioning.

3.22 Bullet Resistant Glass

A. In the fourth year of the O&M phase of the contract, before the warranty expires, verify that no delamination has occurred or unusual distortion has developed. Notify manufacturer if abnormalities are found.

B. Annually

1. Inspect the glass after every impact occurrence. Product should maintain its optical clarity. Verify that clarity has not been compromised.

2. Inspect for signs of delamination or spalls.

3.23 Pattern Glass

A. Semi-Annually

1. Inspect anchors and glass surfaces.

2. Tighten anchors as required to maintain structural integrity of unit.

3. Report glass defect problems to the manufacturer or signs of chipping or crazing around the etched areas.

3.24 Safety Glass, Tempered Glass, Wire Glass

A. Annually

1. Spontaneous breakage should be reported to the manufacturer for replacement of the glass.

2. Notify the manufacturer if delamination is occurring.

2. Replace damaged wire glass to maintain fire-rating.

3.25 Spandrel Glass

A. Annually

1. Inspect the spandrel panels and clean with a product recommended by the manufacturers.

2. Inspect the panels for peeling, cracking or deterioration of the coating and check for signs of seal failure.

3. If defects are noted, notify the manufacturer.

3.26 Mirrors

A. Annually

1. Inspect the mirrors for coating delaminations, surface scratches or any breakage. Repair or replace as required.

2. Verify that mirrors are securely fastened to the walls.

3.27 Carpet Tiles

A. Replace badly soiled carpet tiles that cannot be cleaned by conventional means.

B. Annually

1. Inspect the carpet for adhesion and edge ravels. Check for delamination, flexibility, and colorfastness. If carpet delamination or unusual fading is occurring, repair or replace as required.

C. Semi-Annually

1. Commercially clean the carpet with a method approved by the supplier.

3.28 Resilient Flooring

A. Annually

1. Check resilient floors and accessories for open seams and areas where the adhesion has failed.

2. Repair the seams as required and reattach loose tiles and base.

3. Replace scratched tiles and areas damaged by impact loads.

4. Replace stained tiles as required.

3.29 Terrazzo Flooring

A. Annually

1. Inspect the floors on a yearly basis for cracks, blistering and signs of surface failure or adhesion failure. Repair areas as necessary, matching the original finish

2. Remove deep stains. Reseal and refinish the floors

3.30 Ceramic Tile

A. In the fourth year of the O&M phase of the contract, check and repair grout joints as needed, and replace joint sealants in the floor, base, and thresholds.

B. Annually

1. Every year inspect floors and base for broken or loose tiles. Replace all broken tiles

3.31 Interior Masonry.

A. Annually

1. Inspect walls once a year for impact damage. Replace damaged hollow units and repair solid or filled units with mortar or fill mix, finished to match the adjacent surfaces.

B. Bi-Annually

1. Inspect the interior brick every six months for the first year and yearly thereafter for signs of efflorescence and clean as needed.

3.32 Gypsum Walls

A. Inspect the gypsum walls every two and a half years for surface imperfections caused by impact, nail pull through or joint separation. Verify that the required acoustical sealant is still intact.

1. Repair all impact holes or dings. Reset nails as needed and re-tape any joints that have separated.

3.33 Acoustical Tiles

A. Annually

1. Inspect the ceiling tiles for signs of sagging, moisture stains, discoloration or chipping.
2. Replace the damaged tiles and note the cause.
3. If the damage is abnormal, notify the manufacturer.

3.34 Gypsum Board Ceilings

A. Inspect the gypsum board ceilings every two and a half years. Inspect for cracks and signs of building movement or stresses, which could cause cracks. Note any impact damage and repair as necessary.

3.35 Paint Systems - General

A. In the fourth year of the O&M phase of the contract, repaint exterior finish systems, gypsum ceilings and walls, concrete block, brick, concrete, wood, plaster, high impact panels, taking care to make all necessary repairs before painting.

B. Every 2 ½ Years

1. Repaint all corridors.
2. Repaint all metal surfaces.

C. Annually

1. Inspect painted surfaces on a yearly basis. Check for weathered areas, alligatoring, bleeding, blistering, fading, rusting, chalking, cracking, loose paint, nail stains, dirt and mildew. Note the primary cause either moisture,

inadequate surface preparation, improper initial application, the sun or weathering.

2. Alligatored, bleeding, blistered, cracked or peeling areas should have the paint completely removed. Clean, prime and repaint all areas damaged in the above ways. The presence of mildew or efflorescence indicates that the surfaces must be cleaned, repaired, re-primed and repainted. Look for and remedy the water source. Use a mildewcide in the paints where mildew is a problem.

3. Metals that are showing signs of rust should be wire brushed to bare metal, treated with rust inhibitor, primed and repainted. Rusted nails that have bled through should be reset, coated with rust inhibitor primer, caulked, and painted.

3.36 High-Performance Coatings

A. These coatings are designed to resist moderate or corrosive environments, with intermittent exposure to high humidity and condensation, and other forms of abuse. They require little maintenance over the warranty period, generally 20 years. Regular cleaning and periodic inspection will prolong the life of the coatings.

B. Annually

1. Inspect the coated surfaces to ensure that the coating integrity is intact.
2. Inspect sharp edges, exposed fastener heads, pipe threads, and other surfaces difficult to coat for first signs of coating degradation.
3. Touch up problem areas as needed.
4. Inspect coatings for exposure to adverse conditions that may prematurely degrade the coating system. Report problem conditions to the Owner for possible recoating.
5. Wash and clean surfaces that are coated in accordance with manufacturer’s recommendations to prolong the life of the coating system.

3.37 Acoustical Wall Panels

A. Annually

1. Check panels to ensure fabric edges are tight in frames and fabric is taut. Adjust as required following manufacturer’s instructions.
2. Check fabric for tears and soiled areas that cannot be cleaned. Replace fabric as required.
3. Check panels for permanent depressed areas and panels that have become bowed. Replace panels including framing, core board, and fabric.
4. Clean fabric following manufacturer’s recommended procedures.

3.38 Metal Wall Louvers

A. Annually

1. Check louver blades for accumulated dirt and debris. Clean as needed.
2. Check weep holes in drainable blades and clean as necessary to allow full drainage.
3. Check finish on louvers for signs of deterioration. Report problems to manufacturer for possible replacement.
4. Check all connections and fasteners are tight.
5. Clean screening material as required.
6. Check sealant around perimeter of louvers and replace if necessary under the sealant section.

3.39 Modular Furniture Systems

A. Annually

1. Check that wall panels and supports are secure and there are no missing parts. Tighten fasteners as required.
2. Check condition of fabrics, tops, and pre-finished metal surfaces. Clean fabrics as recommended by the manufacturer. Replace badly soiled or stained panels that cannot be cleaned by standard means.
3. Check edges of work surfaces and re-attach lose edge moldings if applicable.
4. Check work surfaces for scratches and repair following manufacturer’s recommendations.
5. Replace scratched metal trim with attic stock components to match.
6. Check task lighting and replace lamps as required.
7. Check adjustable chairs for proper function. Adjust as necessary. Repair or replace loose, missing, or broken parts.
8. Apply a light coat of lubricant to moving parts such as chair casters.
9. Check wire management system. Verify that cables are in good condition and safe for intended use. Install cover plates if missing.
10. Check drawers, cabinet doors, and shelves for proper function. Replace or repair broken or lose parts.

CHAPTER 4

VOLUME 7 OPERATION AND MAINTENANCE REQUIREMENTS

Operation and Maintenance Statement of Work

Security Systems

Table of Contents

4.0 Security Systems – General Information

A. General Description

1. The O&M Statement of Work is intended to outline the preventive maintenance for each System and their respective subsystems contained in the building. It is intended to be the continuation of the development of a comprehensive operation and maintenance program description that began during design and will be further defined during construction with the completion of the Management Plan & Systems Operation Maintenance Manual.
2. All information contained within this volume shall be performed under the Operation and Maintenance phase of this contract.
3. As more detailed information is obtained during construction with submittal approval and detailed management procedures, the manual will evolve to a detailed and specific scope of work. Information will be further developed and updated in the Management Plan & Systems Operation and Maintenance manual during the five years following construction completion.
4. This chapter is not intended to replace other contract documents, shop drawings, as-built drawings, or equipment manufacturers' instructions; instead, the intent is to supplement such documents and provide a guide to the specific scope of work required by system and equipment. It is intended to augment the understanding of the functioning of each system.
5. The periodic maintenance schedule outlined in this section represents the minimal essential preventive maintenance actions.
   a. The Contractor should consult Manufacturer's documentation for each specific item to supplement this information.
   b. In cases where Manufacturer's data conflicts with the periodic maintenance data in this chapter, the Contractor should follow the Manufacturer's recommendations and update this manual to reflect those changes.

B. Related Information

1. Chapter 1 of this manual details the management systems and defines additional scope required that will facilitate the execution of this comprehensive program. For information linking this section into the overall operation and maintenance program see the following related sections.
   a. VOLUME 7 - Operation and Maintenance Statement of Work (O&M SOW)
   b. Appendix A – Management Plan & Systems Operation and Maintenance Manual Templates

c. Drawings and Specifications, especially Specification Section 01700, Operation and Maintenance Data

d. Equipment Manufacturers' Instructions

C. General Scope of Work

1. The Contractor shall be responsible for the operation, PM, and testing of all security systems in accordance with manufacturers' O&M instructions and applicable NFPA Standards.

D. General Work Practices

1. At the outset of all maintenance described herein, the servicing contractor shall follow appropriate accepted practices and applicable codes (e.g. NFPA, OSHA, etc.) for maintenance personnel protection.

2. Servicing Contractors shall utilize appropriate means, methods, and instruments for servicing all equipment listed herein; e.g., contractor shall verify the use of proper/approved system lubricant, application method, and application quantity. Procurement of said instruments shall be the responsibility of the Service Contractor.

3. All preventive maintenance work listed in this document (either written or implied) shall be performed as to not void any equipment warranties of this facility. All maintenance data listed for each piece of mechanical equipment shall be done, in their entirety, at dates of coinciding maintenance requirements, i.e. monthly maintenance shall not be foregone during times of semi-annual maintenance.

4.1 Access Control and Monitoring System

A. The Contractor shall inspect, maintain, and repair the Access Control and Monitoring System throughout the facility so that it is continuously maintained in complete, reliable, and safe operating condition as originally designed and intended. PM inspections shall be scheduled and coordinated with the Contracting Officer. The security system is a self-diagnostic system that reports and records all system related events. These reports serve as the basis for all non-scheduled maintenance and repairs to insure that the system is operating in a reliable manner. The following list summarizes the principal tests and inspections required.

B. Annually

1. Test and visually inspect alarm devices.

2. Clean and inspect all components.

3. Review reports for indications of system malfunctions.

C. Quarterly

1. Test and visually inspect alarm devices.

2. Test and visually inspect all doors for proper operation.

D. Monthly

1. Clean and inspect all components.
2. Review reports for indications of system malfunctions.

4.2 Security Power System.

A. The Contractor shall inspect, maintain, and repair the Security Power System throughout the facility so that it is continuously maintained in complete, reliable, and safe operating condition as originally designed and intended. PM inspections shall be scheduled and coordinated with the Contracting Officer.

B. The security power system is connected to Access Control and Monitoring System, which provides partial diagnostics on system performance. These reports serve as the basis for all non-scheduled maintenance and repairs to insure that the system is operating in a reliable manner. The following list summarizes the principal tests and inspections required.

1. Annually
   a. Visually inspect all batteries for leakage.
   b. Perform load voltage test on batteries.
2. Bi-annually
   a. Visually inspect all batteries for leakage.
3. Quarterly
   a. Visually inspect and test power system components.
4. Monthly
   a. Visual inspection of all power system components.

4.3 Closed Circuit Television (CCTV) System

A. The Contractor shall inspect, maintain, and repair the Closed Circuit Television (CCTV) System throughout the facility so that it is continuously maintained in complete, reliable, and safe operating condition as originally designed and intended. PM inspections shall be scheduled and coordinated with the Contracting Officer using the recommendations of the equipment manufacturer. The CCTV system is connected to Access Control and Monitoring System. The following list summarizes the principal tests and inspections required.

B. Annually

1. Test and visually inspect alarm devices.
2. Clean and inspect all components.
3. Review reports for indications of system malfunctions

C. Quarterly

1. Test and visually inspect alarm devices.
2. Test and visually inspect all doors for proper operation.

D. Monthly

1. Visual inspection of all CCTV system components
2. Review reports for indications of system malfunctions.

4.4 Vehicle Barriers and Security Gates

A. The Contractor shall inspect, maintain, and repair the Vehicle Barriers throughout the facility so that it is continuously maintained in complete, reliable, and safe operating condition as originally designed and intended. PM inspections shall be scheduled and coordinated with the Contracting Officer. The vehicle barriers are connected to Access Control and Monitoring System, which provides diagnostics on system performance. These reports serve as the basis for all non-scheduled maintenance and repairs to insure that the system is operating in a reliable manner. The following list summarizes the principal tests and inspections required.

B. Annually

1. Visual inspection of all hydraulic system components.

C. Quarterly

1. Visual inspection of all hydraulic system components.
2. Clean and lubricate system components

D. Monthly

1. Visual inspection of all hydraulic system components.

4.5 Intercom

A. The Contractor shall inspect, maintain, and repair the Intercom system throughout the facility so that it is continuously maintained in complete, reliable, and safe operating condition as originally designed and intended. PM inspections shall be scheduled and coordinated with the Contracting Officer using the recommendations of the equipment manufacturer. The intercom provides two-way communication and controls access to selected entrances to the facility/grounds. The following list summarizes the principal tests and inspections required.

B. Quarterly

1. Test all system components for proper operation.

CHAPTER

5

VOLUME 7 OPERATION AND MAINTENANCE REQUIREMENTS

Operation and Maintenance Statement of Work

Fire Protection Systems

Table of Contents

5.0 Fire Protection Systems – General Information

A. General Description

1. The O&M Statement of Work is intended to outline the preventive maintenance for each System and their respective subsystems contained in the building. It is intended to be the continuation of the development of a comprehensive operation and maintenance program description that began during design and will be further defined during construction with the completion of the Management Plan & Systems Operation Maintenance Manual.
2. All information contained within this volume shall be performed under the Operation and Maintenance phase of this contract.
3. As more detailed information is obtained during construction with submittal approval and detailed management procedures, the manual will evolve to a detailed and specific scope of work. Information will be further developed and updated in the Management Plan & Systems Operation and Maintenance manual during the five years following construction completion.
4. This chapter is not intended to replace other contract documents, shop drawings, as-built drawings, or equipment manufacturers' instructions; instead, the intent is to supplement such documents and provide a guide to the specific scope of work required by system and equipment. It is intended to augment the understanding of the functioning of each system.
5. The periodic maintenance schedule outlined in this section represents the minimal essential preventive maintenance actions.
   a. The Contractor should consult Manufacturer's documentation for each specific item to supplement this information.
   b. In cases where Manufacturer's data conflicts with the periodic maintenance data in this chapter, the Contractor should follow the Manufacturer's recommendations and update this manual to reflect those changes.

B. Related Information

1. Chapter 1 of this manual details the management systems and defines additional scope required that will facilitate the execution of this comprehensive program. For information linking this section into the overall operation and maintenance program see the following related sections.
   a. VOLUME 7 - Operation and Maintenance Statement of Work (O&M SOW)

b. Appendix A – Management Plan & Systems Operation and Maintenance Manual Templates

c. Drawings and Specifications, especially Specification Section 01700, Operation and Maintenance Data

d. Equipment Manufacturers' Instructions

A. General Scope of Work:

1. The Contractor shall be responsible for the operation, PM, and testing of all fire protection systems in accordance with manufacturers' O&M instructions and applicable NFPA Standards. The Contractor shall coordinate all maintenance, repair, and testing with the fire department.

B. General Work Practices

1. At the outset of all maintenance described herein, the servicing contractor shall follow appropriate accepted practices and applicable codes (e.g. NFPA, OSHA, etc.) for maintenance personnel protection.

2. Servicing Contractors shall utilize appropriate means, methods, and instruments for servicing all equipment listed herein; e.g., contractor shall verify the use of proper/approved system lubricant, application method, and application quantity. Procurement of said instruments shall be the responsibility of the Service Contractor.

3. All preventative maintenance work listed in this document (either written or implied) shall be performed as to not void any equipment warranties of this facility. All maintenance data listed for each piece of mechanical equipment shall be done, in their entirety, at dates of coinciding maintenance requirements, i.e. monthly maintenance shall not be foregone during times of semi-annual maintenance.

5.1 Automatic Sprinkler Systems

A. The Contractor shall inspect, maintain, and repair the automatic sprinkler and related systems throughout the facility so that they are continuously maintained in complete, reliable, and safe operating condition as originally designed and intended. PM inspections shall be scheduled and coordinated with the Contracting Officer. PM procedures shall conform to the requirements contained in NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, and the recommendations of the equipment manufacturer. Automatic sprinkler systems shall be maintained back to the main water distribution system, including backflow prevention devices, post indicator valves, check valves, and waterflow meters. Spare sprinklers shall be maintained on hand and available for the Contractor's use for each sprinkler system, as required by NFPA 13, Standard for the Installation of Sprinkler Systems. The Contractor shall provide a replacement unit within 14 calendar days after the use of any sprinkler, and shall check and report missing sprinklers and wrenches as part of each PM inspection. The following list summarizes the principal tests and inspections required.

B. Annually

1. Check general condition of sprinklers and sprinkler systems.
2. Conduct main drain tests
3. Trip test dry pipe valves
4. Trip test preaction valves
5. Drain low points in dry pipe and preaction systems.
6. Conduct preventive maintenance of valves.
7. Check for painted or obstructed sprinkler heads. Replace as required.

C. Quarterly

8. Test and visually inspect alarm devices.
9. Visually check air and water pressure in dry pipe and pre-action systems.

D. Monthly

10. Visually inspect gauges.
11. Visually inspect control valves for proper position.

5.2 Fire Detection and Alarm Systems

A. The Contractor shall inspect, maintain, and repair the fixed fire alarm systems and equipment throughout the facility so that they are continuously maintained in complete, reliable, and safe operating condition as originally designed and intended. Electrical connections required to operate alarm systems shall be maintained back to the source of electricity, up to but not including circuit breakers and disconnects. Submit within 30 days of the start of the O&M phase of the contract, a 5-year test plan listing, which detectors are to be tested in each semi-annual test; detectors in each test shall be distributed equally over zones. Concurrently, submit a test plan showing, which fire alarm telephone outlets are to be tested each quarter. PM inspections shall be scheduled and coordinated with the Contracting Officer. PM procedures shall conform to the requirements contained in the current edition of NFPA 72, National Fire Alarm Code®, as well as the recommendations of the equipment manufacturer. The following list summarizes the principal tests and inspections required.

B. Annually

1. Perform operational test of supervisory initiating devices.
2. Perform operational test of manual fire stations.
3. Perform operational test of smoke detectors.
4. Perform operational test of duct smoke detectors.

5. Clean smoke and duct smoke detectors.
6. Perform operational test of indicating devices.
7. Perform operational test of output functions (i.e. AHU shutdown)

C. Semi-annually

1. Visually inspect all initiating, indicating and control equipment.
2. Perform load voltage test on control panel batteries.
3. Perform operational test of waterflow switches.

D. Quarterly

1. Visually inspect waterflow switches.
2. Visually inspect and test supervisory switches.
3. Perform operational test of base system circuits with ground and open faults.

E. Monthly

1. Visual inspection of all fire alarm equipment.

CHAPTER

6

VOLUME 7 OPERATION AND MAINTENANCE REQUIREMENTS

Operation and Maintenance Statement of Work

Plumbing Systems

Table of Contents

Section	Description	Page

6.0 Plumbing Systems - General Information

A. General Description

1. The O&M Statement of Work is intended to outline the preventive maintenance for each System and their respective subsystems contained in the building. It is intended to be the continuation of the development of a comprehensive operation and maintenance program description that began during design and will be further defined during construction with the completion of the Management Plan & Systems Operation Maintenance Manual.
2. All information contained within this volume shall be performed under the Operation and Maintenance phase of this contract.
3. As more detailed information is obtained during construction with submittal approval and detailed management procedures, the manual will evolve to a detailed and specific scope of work. Information will be further developed and updated in the Management Plan & Systems Operation and Maintenance manual during the five years following construction completion.
4. This chapter is not intended to replace other contract documents, shop drawings, as-built drawings, or equipment manufacturers' instructions; instead, the intent is to supplement such documents and provide a guide to the specific scope of work required by system and equipment. It is intended to augment the understanding of the functioning of each system.
5. The periodic maintenance schedule outlined in this section represents the minimal essential preventive maintenance actions.
   a. The Contractor should consult Manufacturer's documentation for each specific item to supplement this information.
   b. In cases where Manufacturer's data conflicts with the periodic maintenance data in this chapter, the Contractor should follow the Manufacturer's recommendations and update this manual to reflect those changes.

B. Related Information

1. Chapter 1 of this manual details the management systems and defines additional scope required that will facilitate the execution of this comprehensive program. For information linking this section into the overall operation and maintenance program see the following related sections.
   a. VOLUME 7 - Operation and Maintenance Statement of Work (O&M SOW)
   b. Appendix A – Management Plan & Systems Operation and Maintenance Manual Templates

c. Drawings and Specifications, especially Specification Section 01700, Operation and Maintenance Data

d. Equipment Manufacturers' Instructions

A. General Scope of Work:

1. The Contractor shall be responsible for the operation, PM, and testing of all plumbing systems in accordance with manufacturers' O&M instructions and applicable NFPA Standards.

C. General Work Practices

1. At the outset of all maintenance described herein, the servicing contractor shall follow appropriate accepted practices and applicable codes (e.g. NFPA, OSHA, etc.) for maintenance personnel protection.

2. Servicing Contractors shall utilize appropriate means, methods, and instruments for servicing all equipment listed herein; e.g., contractor shall verify the use of proper/approved system lubricant, application method, and application quantity. Procurement of said instruments shall be the responsibility of the Service Contractor.

3. All preventative maintenance work listed in this document (either written or implied) shall be performed as to not void any equipment warranties of this facility. All maintenance data listed for each piece of mechanical equipment shall be done, in their entirety, at dates of coinciding maintenance requirements, i.e. monthly maintenance shall not be foregone during times of semi-annual maintenance.

6.1 Plumbing Interior Water System - Gas-fired Water Heaters

A. There are two sets of gas-fired storage water heaters. One set for the Domestic hot water loads (locker room showers, toilet room lavatories, kitchen sinks, etc.) and one set for the hot water uses in the Laboratory spaces (protected).

B. Preventive maintenance on the tanks consists primarily of periodic flushing, and inspection of anode rods. PM on the fuel system consists of checking the burner and fuel gas system, and the flue gas system for signs of distress.

C. Annually

1. Inspect Combustion Chamber

D. Bi-Annually

1. Test and Record flue gas draft pressures

2. Test and record products of combustion and flue gas temperatures

3. Record combustion efficiency range

E. Quarterly

1. Flush water storage tanks

2. Inspect anodes and Diptubes
3. Replace anode if over 25% consumed
4. Inspect expansion tanks for leaks and general condition

F. Monthly

1. Check and record pressure and temperature gauges
2. Check recirculation pumps and return line temperatures

G. Weekly

1. Inspect for leaks, signs of corrosion or relief discharges

6.2 Plumbing Interior Water System - Backflow Prevention Devices

A. Annually

1. Perform full operating tests on Reduced Pressure Backflow Preventers (RPBP) in accordance with the 9th edition of the Cross Connection Control Manual, as published by The Foundation For Cross Connection Control and Hydraulics Research of the University of Southern California.
2. Test kit furnished under the Bldg Construction Contract.
3. RPBP's are duplexed to maintain Lab operations during the testing.

B. Bi-Annually

1. Check inventory of spare parts: at least one set of replacement parts for each size of RPBP station.
2. Perform full test (annual level) if any RPBP has failed to perform.

C. Monthly

1. Check backflow preventors assemblies for signs of leaks or discharge.
2. Inspect and record pressure readings, and pressure drop at load.

6.3 Plumbing Interior Water System - Pure Water System

A. Annually

1. Rebuild chemical feed pumps
2. Replace Post filter cartridge
3. Replace tank vent filter
4. Sanitize the CEDI unit
5. Replace Ultraviolet lamps
6. Test and sanitize storage tank
7. Test and sanitize distribution loop

B. Monthly

1. Check Multimedia filter functions
2. Inspect and record Multimedia regeneration data
3. Check distribution pump operation
4. Check softener functions
5. Record softener consumption
6. Check reverse osmosis units
7. Check control panel and instruments
8. Lab-Test water quality at sample ports
9. Check Ultraviolet lamp operation
10. Record return loop temperature
11. Test return loop dump valve
12. Inspect storage tank for leaks and biofilm

6.4 Laboratory Vacuum System

A. The central laboratory vacuum system consists of three major components:

1. The duplex vacuum pump package in the central mechanical plant.
2. The distribution piping network.
3. The terminal bench and fumehood outlets.

B. The skid-mounted vacuum pump set contains two oil-flooded pumps, vertically stacked, with an expandable frame. A third pump can be added to the top of the support frame, allowing for future expansion of the system. The pumps use rotary vanes sealed by a synthetic oil that can resist the effects of mild chemical vapors.

C. Each pump will displace approximately 28 cubic feet per minute, pulling a vacuum of about 25 inches mercury. The setting of the vacuum level is adjustable at the control panel on the skid. A common setting is between 20 and 25 inches mercury. Higher level settings, approaching 29 inches, are not appropriate for this type of system; those levels (called High-Torr) are achieved by the specialized pumps associated with specific Lab equipment.

D. The piping network extends from the central mechanical plant to Fumehoods and bench outlets in the Labs. Each of the major Lab discipline areas can be isolated from the main corridor vacuum piping without affecting other Lab units.

E. The piping is a smooth copper tube. The tubing connects to a central receiver where liquids are collected and discharged to the Laboratory waste piping system.

F. The vacuum outlets are more correctly “inlets” because of the direction of flow. The most common inlet is the classic Fumehood serated "“cock" built into the hoods. The vacuum level will decrease over the length of the piping system, and hood inlets will have vacuum in the range of 15 to 19 inches mercury, depending on the central pump setting.

G. Annually

1. Inspect and replace inlet filter cartridge

H. Bi-annually

1. Inspect inlet filter cartridge
2. Change exhaust filters
3. Check oil fill gauge pressure

I. Quarterly

1. Drain and replace oil and oil filters.

J. Monthly

1. Compare lead lag runtime hours

K. Weekly

1. Inspect oil level
2. Inspect receiver liquid levels
3. Check exhaust pressure gauge for normal operation.
4. Check purge system
5. Check receiver and system piping for leaks

6.5 Laboratory Waste System

A. The Laboratory Waste (LW) system is a network of mostly underground drainage piping. This gravity drainage system uses corrosion resistant polypropylene piping with heat-fused joints. The Labwaste piping is separate from the standard domestic drainage piping system that serves toilet rooms, showers, and other non-chemical flows.

B. The Labwaste drainage exits the facility in two points north and south of the front entrance to the Lab. Here the separate waste lines enter Monitoring manholes that each contains a pH monitoring assembly. The pH monitor is an inline probe that relays the pH reading of the waste back to digital panels in the BAS room.

C. The waste stream then runs from the monitoring manhole to join the “sanitary” waste stream at an adjacent site manhole. The expectation of the program is that the LW stream will be diluted in the mixture before heading for the Fort Gillem wastewater treatment plant. The monitoring system will keep digital records of the LW pH, and shall be set to alarm in the BAS room if the pH exceeds proper range variances.

D. Quarterly

1. Remove and inspect the LW monitoring pH probes

E. Monthly

1. Check the Labwaste Monitoring manholes
2. Check BAS room monitoring panel signals
3. Test alarm outputs and annunciation

CHAPTER 7

VOLUME 7 OPERATION AND MAINTENANCE REQUIREMENTS

Operation and Maintenance Statement of Work

Mechanical Systems

Table of Contents

7.0 Mechanical Systems General Information

A. General Description

1. The O&M Statement of Work is intended to outline the preventive maintenance for each System and their respective subsystems contained in the building. It is intended to be the continuation of the development of a comprehensive operation and maintenance program description that began during design and will be further defined during construction with the completion of the Management Plan & Systems Operation Maintenance Manual.
2. All information contained within this volume shall be performed under the Operation and Maintenance phase of this contract.
3. As more detailed information is obtained during construction with submittal approval and detailed management procedures, the manual will evolve to a detailed and specific scope of work. Information will be further developed and updated in the Management Plan & Systems Operation and Maintenance manual during the five years following construction completion.
4. This chapter is not intended to replace other contract documents, shop drawings, as-built drawings, or equipment manufacturers' instructions; instead, the intent is to supplement such documents and provide a guide to the specific scope of work required by system and equipment. It is intended to augment the understanding of the functioning of each system.
5. The periodic maintenance schedule outlined in this section represents the minimal essential preventive maintenance actions.
   a. The Contractor should consult Manufacturer's documentation for each specific item to supplement this information.
   b. In cases where Manufacturer's data conflicts with the periodic maintenance data in this chapter, the Contractor should follow the Manufacturer's recommendations and update this manual to reflect those changes.

B. Related Information

1. Chapter 1 of this manual details the management systems and defines additional scope required that will facilitate the execution of this comprehensive program. For information linking this section into the overall operation and maintenance program see the following related sections.
   a. VOLUME 7 - Operation and Maintenance Statement of Work (O&M SOW)
   b. Appendix A – Management Plan & Systems Operation and Maintenance Manual Templates

c. Drawings and Specifications, especially Specification Section 01700, Operation and Maintenance Data

d. Equipment Manufacturers' Instructions

C. General Scope of Work

1. The Contractor shall be responsible for the operation, PM, and testing of all plumbing systems in accordance with manufacturers' O&M instructions and applicable NFPA Standards

D. General Work Practices

1. At the outset of all maintenance described herein, the servicing contractor shall follow appropriate accepted practices and applicable codes (e.g. NFPA, OSHA, etc.) for maintenance personnel protection.

2. Servicing Contractors shall utilize appropriate means, methods, and instruments for servicing all equipment listed herein; e.g., contractor shall verify the use of proper/approved system lubricant, application method, and application quantity. Procurement of said instruments shall be the responsibility of the Service Contractor.

3. All preventative maintenance work listed in this document (either written or implied) shall be performed as to not void any equipment warranties of this facility. All maintenance data listed for each piece of mechanical equipment shall be done, in their entirety, at dates of coinciding maintenance requirements, i.e. monthly maintenance shall not be foregone during times of semi-annual maintenance.

7.1 Air Cooled Chiller

A. Annually

1. Perform Meg test on compressor windings.

2. Inspect compressors and record condition(s) for future comparisons.

3. Check electrical contacts for pitting and replace as needed.

4. Clean and vacuum motor disconnect switch.

5. Perform current check on each phase of motor.

6. Test waterside safety valve(s). Operating pressure shall be tested by bring the valve to its relief setting. The valve should "pop" and then re-seat according to the valve stamping.

7. Verify motor starter overload settings and trip(s).

8. Inspect refrigerant lines and accessories: compressor suction and discharge service valves; liquid line shut-off valve; removable core filter drier; liquid line sight glass with moisture indicator; strainers; charging point; and electronic expansion valve.

9. Oil System:
    a. Check oil quantity and replenish if required.
    b. Inspect oil heater.
    c. Inspect oil pump, oil separator, filtration devices, check valves, and solenoid valve(s).
    d. Perform leak test on compressor fittings, terminals, piping fittings, oil piping, oil pump, and pressure vessels.

B. Bi-Annually

1. Clean evaporator shell and remove any debris. Inspect for corrosion. Record condition of evaporator for comparison purposes.
2. Check all compressor bolts and tighten where needed.
3. Check vibration isolation, inertia pads, and structural steel dunnage for cracks, crumbling, and bending. Repair/replace as needed.
4. Check refrigerant charge in each compressor circuit. Provide additional refrigerant as required.
5. Condenser Coils:
6. Comb and vacuum finned coils.
7. Check the balance of each condenser fan and rebalance if necessary.
8. Check fan bearings and lubricate based on unit manufacturer's recommendations.
9. Check fan rotation upon start-up after maintenance is complete.
10. Record condition of condenser fans, motors, and coil for future comparison.

C. Monthly

1. Log entering and leaving water temperatures and record results.
2. Inspect general appearance of chiller. Report any cracks, rust spots, water leaks.
3. Inspect chiller isolation valves, clean strainers, and inspect piping connections for fatigue/damage.
4. Verify glycol content of chiller water system. If content is below design level, fill until proper percentage is reached.
5. Record make-up water usage and log results.
6. Verify inlet and outlet water temperatures while chiller is at full capacity. Record data and store results for comparison of next month's readings.
7. Record water pressure drop across evaporator (at full flow) and record results. Compare results with that of the previous month to determine if evaporator tubes have become fouled.

8. Check oil line temperature.
9. Inspect integral chilled water flow switch for proper operation. Repair or replace as required.
10. Run manufacturer recommended Control Diagnostic for all appurtenances of chiller. Log results and magnitude of any deviations found. Recalibrate where required.

7.2 Pumps (Chilled, Hot, and Freeze protection)

A. Annually

1. Check electrical contacts for pitting and replace as needed.
2. Clean and vacuum motor disconnect switch.
3. Perform current check on each phase of motor.
4. Verify pump performance curves while pump is operating at peak capacity.
5. Verify proper rotation of impeller upon start-up after maintenance is complete.

B. Bi-Annually

1. Check associated VFD and run diagnostics to verify operation.
2. Statically and dynamically balance motor shaft.
3. Check vibration isolation and any inertia pads – inspect for cracks and misalignment – repair as needed.
4. Check motor/impeller coupling for proper alignment.
5. Inspect bearings for wear and roundness.
6. Check water seals and volute gasket for integrity – replace as necessary.
7. Remove volute casing and inspect impeller and casing for corrosion, divets, wear, and impeller build-up – replace/repair as needed.

C. Monthly

1. Check for excessive vibration of the pump (with respect to the listed maximum permissible vibration Levels of the pump).
2. Vacuum motor vents to prevent overheating of motor.
3. Inspect pump for unusual noise/sound levels. Noise may indicate the need to lubricate bearings or misalignment of shaft.
4. Report wet motor insulation and repair accordingly.
5. Clean out strainers, check isolation valves, re-calibrate balancing valves, inspect piping connections for integrity.

6. Check shaft and coupler for straightness/deflection. Log results and compare with measurements taken from previous month to record any slippage.
7. Check vertical piping supports for cracking or deflection.
8. Lubricate pump bearings according to specific fan manufacturer's recommendations (weekly to monthly).
9. Record pressure drop across pump using pump's integral pressure ports.
10. Clean diffuser section (if used).
11. Check / calibrate any Triple Duty valves.

7.3 Fans

A. Lubricate motor bearings after 3 full years of service.

B. Annually

1. Check electrical contacts for pitting and replace as needed.
2. Clean and vacuum motor disconnect switch.
3. Perform current check on each phase of motor.
4. Verify fan performance curves while fan is operating at peak capacity.
5. Verify proper rotation of fan wheel upon start-up, after maintenance is complete.

C. Bi-Annually

1. Verify operation of associated VFD(s) and verify control parameters.
2. Check fan belts for wear/fraying and replace as needed.
3. Verify operation and condition of any associated dampers and end switches.
4. Verify damper full open and full close positions to ensure proper range of actuation.
5. Inspect all bolts and set screws for tightness.
6. Verify and check sheave position(s) and condition – replace/repair as needed.
7. Inspect fan wheel and interior housing for any divets, burrs, scoring, or debris build-up – wipe clean and repair as needed.
8. Check internal housing, fan wheel, and shaft for corrosion/erosion/metal fatigue – replace/repair as needed.
9. Inspect any inlet or discharge sound attenuators and wipe clean/repair as required.
10. Check stability of vertical guide wires – tighten as needed (utility set fans)

11. Clean and vacuum rodent screen to remove debris – replace/repair as needed.

12. Check vibration isolation and any inertia pads – inspect for cracks and spring misalignment – repair as needed.

13. Verify proper rotation of fan wheel upon start-up after maintenance is complete.

14. For Fan 1.17- Inspect associated exhaust duct snorkel system for damage and corrosion.

15. For Fan 1.17- Inspect associated exhaust air louver for debris. Vacuum louver clean.

D. Monthly

1. Replace grease collector every 30 to 45 days (Kitchen fans).

2. Inspect fans exhausting corrosive/contaminated air within the first month of service. Then check every 3 months after.

3. Check for excessive vibration of the fan (based upon unit manufacturer's maximum vibration levels). If excessive vibration exists, shut down and lock out fan until problem is corrected.

4. Lubricate fan bearings with a petroleum lubricant in a lithium base. The lubricant shall be a lithium-based grease conforming to NLGI grade 2 consistency. For best results, apply lubrication while fan is in operation.

5. Check fan inlet and outlet conditions; inspect for any cracking or separating of ductwork.

6. Check fan motor bearings, shaft, and fan/motor coupling for proper alignment.

7. Check fan for grease build-up (kitchen fans).

8. Vacuum motor vents to prevent overheating of motor.

9. Record motor temperature at fully loaded condition.

10. Inspect fan motor structure for general appearance and integrity. Report any cracks or excessive exterior corrosion.

11. Inspect fan roof curb for integrity and water leaks. Report any observed damage.

12. Examine motor mounting plate and tighten restrainer bolts as required.

13. Inspect ductwork connection flanges for cracks and loose bolts.

14. Inspect fan for unusual noise/sound levels. Noise may indicate the need to lubricate fan bearings.

15. Verify proper rotation of fan wheel upon start-up after maintenance is complete.

7.4 Boiler (Natural Gas Fired)

E. Annually

1. Clean all fireside surfaces (with brush or powerful vacuum). Remove all soot.
2. Clean boiler breeching if all associated boilers are scheduled to be "off". Inspect breeching and stack and remove soot.
3. Clean all waterside surfaces. Thoroughly wash all waterside surfaces.
4. Check fluid levels on all hydraulic valves. If leakage is apparent, take immediate action to repair.
5. Inspect sight glass for cracks and damage; replace as necessary.
6. Test safety valve(s). Operating pressure shall be tested by bring the valve to its relief setting. The valve should "pop" and then re-seat according to the valve stamping.
7. Chemical feed system for the hot water heating system should be completely emptied and flushed. Inspect any associated metering valves or pumps and perform required repair (if required).
8. Inspect and tighten all electrical terminals.
9. Check electrical contacts for pitting and replace as needed.
10. Clean and vacuum unit disconnects.
11. Perform current check on each phase of blower motor and all other motors.

B. Bi-Annually

1. Open boiler access doors and inspect refractory. Report any damage and repair immediately.

C. Monthly

1. Inspect burner operation; visually inspect pilot flame and burner flame throughout the firing range. Inspect the free movement of burner linkages.
2. Inspect exterior of boiler jacket for hot spots. Record any unusually hot areas. Hot spots may indicate the cracking or damage of internal refractory.
3. Analyze combustion air. Perform flue gas analysis spanning the entire burner firing range. Compare combustion analysis and stack temperature readings with analysis from the preceding month.
4. Inspect unit concrete inertia pad for cracking and crumbling.
5. Inspect cams for wear and cracking. Check the tightness of all setscrews, movement of all linkages, and alignment of all moving parts. Apply lubrication to moving pieces as required to ensure unhindered movement.

6. Check lubrication of all bearing supported equipment.
7. Check all combustion air inlets to the boiler room for blockage and proper damper actuation to ensure that the proper quantity of combustion air is entering the room.
8. Check for any flue gas leaks to ensure no flue gas is being introduced into the room. Repair as required.
9. Inspect natural gas line for general appearance. Report any damage or leaks noticed.
10. Verify inlet and outlet water temperatures while boiler is at full capacity. Record data and store results for comparison of next month readings.
11. Check access hinges for both doors.
12. Inspect access door locks and seals.
13. Record natural gas pressure and store readings.
14. Record make-up water usage and log results.
15. Inspect boiler isolation valves, clean strainers, inspect piping connections.

7.5 Variable Air Volume (VAV) Boxes

A. Annually

1. Inspect housing seams for integrity, cracks, and air leaks. Repair/patch as required.
2. Inspect inlet and outlet ductwork connections. Ensure that each connection is free of blockage and voids. Repair any damaged external insulation at these locations.
3. Ensure full air damper modulation by testing actuator from complete closure through fully open position.
4. Inspect pneumatic control tubes for leaks, blockage, and proper control air pressure (if pneumatic actuators are used).
5. Inspect air damper shaft and damper blade for integrity, cracks, and breaks. Replace damaged parts.

B. Bi-Annually

1. Inspect internal box lining and report any damaged, worn, or frayed insulation. Repair lining as needed.
2. Inspect actuator linkage for proper range of motion. Lubricate if required.
3. Wipe clean inlet air probe.
4. Open upstream and downstream access panels and inspect hot water coil (refer to Water Coil maintenance).

5. Verify proper operation of water valve actuator from fully open to full closed position (refer to water valve maintenance).

6. Check piping for water leaks. Visually inspect surrounding ceiling tile for water stains.

7.6 Water Valves (larger valves scheduled)

A. Annually

1. Inspect valve seat for excessive wear and pitting/compression.
2. Inspect valve trim for damage and drawing of edges.

B. Bi-Annually

1. Inspect hand wheel and/or operator for cracking and damage.
2. Verify / recalibrate actuator for full modulation and control.
3. Check pneumatic tubing for leakage, blockage, and proper pressure.

C. Monthly

1. Check valve and immediate area for water leakage.

7.7 Laboratory Air Handling Units (Supply Air)

A. Annually

1. Check electrical contacts for pitting and replace as needed.
2. Clean and vacuum motor(s) disconnect switch(es).
3. Perform current check on each phase of fan motor(s).
4. Check unit baserail for buckling, bending, and cracking.
5. Inspect roof curb for damage to flashing and counter flashing. Check for signs of water infiltration into curb and building roof.
6. Inspect exterior subfloor (if accessible). Report any cracks, exposed insulation, water and air leaks.

B. Bi-Annually

1. Inspect general appearance of unit and report any damaged/rusted areas.
2. Verify operation of associated VFD(s) and verify control parameters.
3. Inspect (internal and external) unit casing (roofs, walls, and floor) seams for water and air leaks (repair as needed).
4. Locate water stains, panel separation from other components (e.g. walls separating from unit baserail; wall panels separating from each other at seams), and corrosion (repair as needed).
5. Inspect unit exterior for cold spots, which may indicate internal insulation damage.

6. Verify that all unit drain caps (for each unit module) are installed. Replace any missing caps.

7. Inspect all unit access doors and associated gasketing:

   a. Check for air leakage.
   b. Inspect for cracks/rips in gaskets.
   c. Inspect access door locking mechanisms for proper function.
   d. Record any access doors that are bowing outwards (indicating higher than designed internal pressure).

8. Twice during peak cooling season log results from supply fan VFD that indicate the total air quantity developed at the fan and the corresponding (total connected) air flow rate from each associated VAV box. Compare results from previous readings and chart any deficiencies found. Deficiencies may indicate increased ductwork leakage, ductwork balance, control system mis-calibration, or VAV box inlet probe blockage.

9. Inspect cross-connection ductwork between AHU's for cracking, insulation damage, flexible connector damage, and water leakage. Check ductwork drains for any obstructions **(except AHU-1.6).**

10. Verify operation of automatic control damper(s) and end switches located at discharge plenum. Test damper operation from full open to full closed position.

11. Check each convenience electrical outlet for operation. Repair where necessary.

12. Inspect unit's chilled water, hot water, RODI water (Reference Chapter 6 - Plumbing Systems), and air piping connections for corrosion and insulation damage (repair as required).

13. Verify operation of actuating valves.

14. Verify outside air damper(s) and end switch(es) control. Test damper to ensure full range of motion (full open to full close). Grease damper linkage if required.

15. **AHU-1.6:** Verify minimum outside air, return/relief air, and economizer damper control. Test dampers to ensure full range of motion (full open to full close). Grease damper linkages if required.

C. Monthly

1. Controls Contractor shall verify all safety shut down protocols and hardware for proper operation/actuation: smoke detector, smoke damper, high static pressure, low static pressure, and freezestat, etc.

2. Inspect outside air and exhaust air openings and weather hoods. Vacuum air openings and remove any debris from hood.

3. **AHU-1.6:** Inspect minimum outside air, return/relief air, and economizer air openings and hoods. Vacuum air openings and remove any debris from hoods.
4. Check operation of each unit-mounted light (interior and exterior).
5. Inspect air pressure drop across unit-mounted filters. Filters should be changed every two months or when the pressure drop exceeds 90 percent of the maximum recommended pressure drop, which ever occurs first.
6. Inspect any vestibule fan coil units and perform maintenance as outlined below (see Fan Coil Unit maintenance data).
7. Inspect condensate drain system:
8. Check for free flow of condensate through all cooling coil drain pipes (clean as required).
9. Inspect drain traps (clean as required).
10. Wipe clean the supply fan diffuser plate of any built-up debris.
11. Inspect unit freeze-stat for proper operation.
12. Inspect unit intake module for debris.
13. Inspect unit's integral pressurized supply air plenum connections to vestibule mounted VAV boxes.

D. Supplemental Maintenance Requirements:

1. Perform maintenance for the following accessories as outlined in other parts of this manual.
    a. Supply air Fan. (refer to fan section).
    b. Return air Fan (AHU-1.6). (refer to fan section).
    c. Cooling and Heating Coil. (refer to water coil section).
    d. Hot water Circulating Pump. (refer to water pump section).
    e. Atomizing Humidifier. (refer to humidifier section).

7.8 Laboratory Exhaust Units (Exhaust Air)

A. Annually

1. Check electrical contacts for pitting and replace as needed.
2. Clean and vacuum motor(s) disconnect switch(es).
3. Perform current check on each phase of fan motor(s).
4. Check unit baserail for buckling, bending, and cracking.
5. Inspect roof curb for damage to flashing and counter flashing. Check for signs of water infiltration into curb and building roof.

6. Inspect exterior subfloor (if accessible). Report any cracks, exposed insulation, water and air leaks.

B. Bi-Annually

1. Inspect general appearance of unit and report any damaged/rusted areas.
2. Verify operation of associated VFD(s) and verify control parameters.
3. Inspect (internal and external) unit casing (roofs, walls, and floor) seams for water and air leaks. Locate water stains, panel separation from other components (e.g. walls separating from unit baserail; wall panels separating from each other at seams), and corrosion – repair as required.
4. Verify that all unit drain caps (for each unit module) are installed. Replace any missing caps.
5. Inspect all unit access doors and associated gasketing:
   a. Check for air leakage.
   b. Inspect for cracks/rips in gaskets.
   c. Inspect access door locking mechanisms for proper function.
   d. Record any access doors that are bowing outwards (indicating higher than designed internal pressure).
6. Inspect cross-connection ductwork between Exhaust Units for cracking, insulation damage, flexible connector damage, and water leakage. Check ductwork drains for any obstructions.
7. Verify operation of automatic control damper located at discharge plenum. Test damper operation from full open to full closed position. Grease damper linkage if required.
8. Check each convenience electrical outlet for operation. Repair where necessary.

C. Monthly

1. Check operation of each unit-mounted light (interior and exterior).
2. Inspect any vestibule fan coil units and perform maintenance as outlined below (see Fan Coil Unit maintenance data).
3. Inspect unit's integral pressurized exhaust air plenum connections to vestibule mounted exhaust air boxes.

D. Supplemental Maintenance Requirements:

1. Perform maintenance for the following accessories as outlined in other parts of this manual.
   a. Fan. (refer to fan section).

7.9 Water Coils (Heating and Cooling)

A. Annually

1. Vacuum coil face and comb coil fins.
2. Verify operation of in-line circulator pump for larger coils (refer to pump maintenance data).

B. Bi- Annually

1. Verify proper operation of water valve actuator from fully open to fully closed (refer to water valve maintenance data).
2. Clean strainer.
3. Check balancing valve for proper calibration.
4. Check coil piping for water leaks, visually inspect insulation for corroding and water stains.
5. Check water pressure drop through coil to ensure design pressure drop has not been exceeded.
6. Verify operation of air vents.
7. Check coil header for leaks.

7.10 Atomizing Humidifier

A. Annually

1. Remove air cap at the front of each nozzle and inspect.
2. Check air cap orifice for wear.
3. Integral piston(s) shall be removed, cleaned, and regreased.
4. Recalibrate all sensor(s) according to manufacturer's written instructions.
5. Open regulators, solenoids, and valves and inspect them for wear. Clean all parts and replace worn parts.

B. Bi-Annually

1. Clean water nozzle (located inside air cap) according to recommended cleaning procedures. Specific cleaning solutions and cloth material may be required.
2. "Blow-out" both the air and water lines to remove any debris or sediment.

7.11 Air Compressor and Associated System Components

A. Annually

1. Check electrical contacts for pitting and replace as needed.
2. Clean and vacuum motor disconnect switch.
3. Perform current check on each phase of motor.

4. Test and calibrate all safety valves associated with Air Compressor.
5. Inspect operation of Air Compressor isolation valves. Replace valves if required.
6. Inspect unit(s) once (each) annually to determine if noise radiated from equipment exceeds 84 dBA at a distance one meter from unit. If noise radiated exceeds 84 dBA, remedy situation.
7. Inspect unit mounting surface for damage. Report any concrete cracks and/or unit base rail bending. If vibration isolation is used, inspect springs/neoprene pads and log results of inspection. List location of spring/pad that indicate excessive wear. Replace if required.
8. Log total time of compressor operation and compare to previous year. Report any increase in time that exceeds 10-percent of prior year.

B. Bi-Annually

1. Periodically bleed the compressor to remove any debris or condensed water accumulation.
2. Inspect compressor mounting structure/vibration isolation and report any damage.
3. Inspect unit’s motor bearings for wear. Re-grease as required.
4. Inspect unit aftercooler for proper operation – repair / replace as required.
5. Inspect operation of thermostatically controlled immersion oil heater. Verify oil heater is producing the required heat dissipation to maintain oil at the proper viscosity. Repair/replace as required.
6. Verify operation of integral intercooler fan(s) and test to ensure fan(s) are providing airflow required for proper unit cooling. Replace fans / motors as required.
7. Replace inline oil filters.
8. Air Dryers:
   a. Verify dryers are operating at peak refrigeration charge. Re-charge system refrigerant if required.
   b. Clean/vacuum all air vents to facilitate unit self-cooling.
   c. Inspect Wet air receiver tank and Dry air receiver tank for any indications of leakage. Inspect integral condensate drain valves for proper operation. Log results of inspection / replace drain valve(s) if required.
   d. Record the length of time required by the air compressor to charge the Compressed air system in total. Compare result from prior test and report if time is deficient by more than 10-percent.

e. Check all system pressure regulators for proper operation. Replace any damaged regulators.

C. Monthly

1. Replace coalescing pre-filter and after filters every 45 days.
2. Replace inlet air filter(s) every 30 days.
3. Inspect any and all system inline strainers every 30 days. Replace as required.
4. Maintain intercooler free of debris and fouling to ensure proper unit cooling.
5. Inspect piping connections to compressor for any cracking or separating from compressor. Report any damage found and repair accordingly.
6. Inspect for any unusual noises that may indicate need for lubrication or unbalanced condition resulting from bearing wear. Report and log all instances.
7. Maintain adequate level of oil in crankcase.
8. Lubricate the compressor.
9. Clean/vacuum all motor vents to prevent motor(s) from overheating.
10. Inspect air compressor and system condensate water traps for proper operation. Replace any traps that are stuck in their “open” or “closed” positions.
11. Inspect/monitor the air lubricant separator for unacceptable pressure drop. Initial separator pressure drop is usually around 13.8 kPA to 20.7 kPA.
12. Relocate any stored chemicals or hazardous/noxious substances that may be stored in the vicinity of the air inlet to the compressor.

D. Daily

1. Inspect compressor lubricant levels daily. Re-fill/top-off lubricant level as required.

7.12 Expansion Tank

A. Bi-Annually

1. Check tank for signs of corrosion and external leakage.
2. Test the bladder pre-charge pressure. If pressure is below manufacturer setting, re-charge. Follow manufacturer’s written instructions.
3. Inspect tank mounting surface and report any damage, crumbling, or bending of structure.

4. Test relief valve(s). Operating pressure shall be tested by bring the valve to its relief setting. The valve should gradually open as pressure increases. The valve should then re-seat as pressure is reduced.

5. Test automatic air vent installed in piping connected to main.

7.13 Air Separator

A. Bi-Annually

1. Clean integral strainer.

2. Inspect for water leaks.

3. Test automatic air valve.

4. Inspect for external signs of corrosion and leakage.

7.14 Chemical Treatment (Water systems)

A. Annually

1. Clean and inspect the internal components of chemical treatment feeder. Inspect for corrosion and leaks.

2. Operate all integral drain and vent lines to locate any obstructions. Remedy any obstructions found.

3. Inspect chemical feeder valves (isolation, check, etc.) for proper operation. Replace as required.

B. Bi-Annually

1. Inspect chemical feeder piping, joints, and connections to cooling/heating water system. Look for cracks and locations of possible joint failure. Report findings and repair system as needed.

7.15 Water Systems (Cooling and Heating)

A. Annually

1. Perform walking inspection of water systems and locate areas of leakage (pooled water, stained ceiling tiles, etc.). Report findings and schedule maintenance for damaged location.

2. Inspect system for integrity of piping insulation. Report any damaged, ripped, wet, corroded, or frayed insulation and repair as required.

3. Perform water quality test of each water system.

B. Quarterly

1. Testing coupons shall be supplied and inspected every 3 months and results shall be recorded.

7.16 Fan Coils/Unit Heaters

A. Perform fan maintenance (refer to fan maintenance).

B. Perform water coil maintenance (refer to coil maintenance).

7.17 HEPA Filters

A. Quarterly

1. Monitor HEPA filter pressure drop and replace filters when maximum air pressure drop is within 90 percent of recommended use.

CHAPTER

8

VOLUME 7 OPERATION AND MAINTENANCE REQUIREMENTS

Operation and Maintenance Statement of Work

Electrical Systems

Table of Contents

8.0 Electrical Systems General Information

A. General Description

1. The O&M Statement of Work is intended to outline the preventive maintenance for each System and their respective subsystems contained in the building. It is intended to be the continuation of the development of a comprehensive operation and maintenance program description that began during design and will be further defined during construction with the completion of the Management Plan & Systems Operation Maintenance Manual.
2. All information contained within this volume shall be performed under the Operation and Maintenance phase of this contract.
3. As more detailed information is obtained during construction with submittal approval and detailed management procedures, the manual will evolve to a detailed and specific scope of work. Information will be further developed and updated in the Management Plan & Systems Operation and Maintenance manual during the five years following construction completion.
4. This chapter is not intended to replace other contract documents, shop drawings, as-built drawings, or equipment manufacturers' instructions; instead, the intent is to supplement such documents and provide a guide to the specific scope of work required by system and equipment. It is intended to augment the understanding of the functioning of each system.
5. The periodic maintenance schedule outlined in this section represents the minimal essential preventive maintenance actions.
    a. The Contractor should consult Manufacturer's documentation for each specific item to supplement this information.
    b. In cases where Manufacturer's data conflicts with the periodic maintenance data in this chapter, the Contractor should follow the Manufacturer's recommendations and update this manual to reflect those changes.

B. Related Information

1. Chapter 1 of this manual details the management systems and defines additional scope required that will facilitate the execution of this comprehensive program. For information linking this section into the overall operation and maintenance program see the following related sections.
    a. VOLUME 7 - Operation and Maintenance Statement of Work (O&M SOW)
    b. Appendix A – Management Plan & Systems Operation and Maintenance Manual Templates

c. Drawings and Specifications, especially Specification Section 01700, Operation and Maintenance Data

d. Equipment Manufacturers' Instructions

A. General Scope of Work

1. The Contractor shall be responsible for the operation, PM, and testing of all electrical systems in accordance with manufacturers' O&M instructions and applicable NFPA Standards.

B. General Work Practices

1. At the outset of all maintenance described herein, the servicing contractor shall follow appropriate accepted practices and applicable codes (e.g. NFPA, OSHA, etc.) for maintenance personnel protection.

2. Servicing Contractors shall utilize appropriate means, methods, and instruments for servicing all equipment listed herein; e.g., contractor shall verify the use of proper/approved system lubricant, application method, and application quantity. Procurement of said instruments shall be the responsibility of the Service Contractor.

3. All preventive maintenance work listed in this document (either written or implied) shall be performed as to not void any equipment warranties of this facility. All maintenance data listed for each piece of mechanical equipment shall be done, in their entirety, at dates of coinciding maintenance requirements, i.e. monthly maintenance shall not be foregone during times of semi-annual maintenance.

4. Electrical equipment deterioration is normal, however an effective preventative maintenance program can identify and mitigate the consequences of normal deterioration. In addition to the normal deterioration there are various factors that can contribute to an accelerated deterioration and potential equipment failures. These factors include electrical as well as environmental conditions. Electrical factors include load changes or additions, use voltage levels, excessive loading, improperly set protection devices, as well as others. Environmental factors include excessive heat, moisture, dust, and dirt as well as others. An effective maintenance program can help to minimize these factors and therefore minimize their effects.

5. Initial acceptance testing data for the electrical systems will serve as a basis for subsequent maintenance, maintenance testing and maintenance records.

6. Since the possibility of accidental tripping and harm to maintenance personnel exists when servicing energized electrical equipment, the apparatus should be taken out of service to perform the necessary maintenance when possible. Visual inspections such as observation of

load readings, operating temperatures, ventilation, examination for contamination dirt and debris should be carried out on a continual basis.

7. Other inspections and inspection intervals depend upon many factors including environmental, operational, reliability, safety, cost of equipment replacement, cost of maintenance, the critical nature of the equipment etc. The text and tabulation in this document may serve as an initial starting point and should be adjusted based upon the well documented operational and maintenance history of the equipment.

8. Equipment grounding measurements (point to point) are included with the tests for the equipment and should be performed at the same time the equipment is tested. Any resistance values which exceed 0.5 ohms should be investigated.

9. Protection tests should include:

    a. control circuit operations

    b. long time delay & pick-up

    c. short time delay & pick-up

    d. ground fault delay & pick-up

    e. instantaneous pick-up

10. Visual inspections may include any or all of the following, where applicable, that may be safely accomplished while the equipment is in operation: Checks for moisture, previous wetness, dirt, excessive dust, signs of excessive heat (discoloration), excessive wear, chipping, peeling, cracking, pitting of contact surfaces, infestation, adequate ventilation, fuse sizes, protection settings etc.

11. Complete visual inspections should be accomplished at the same time as the cleaning process while the equipment is de-energized and should include all visual inspections including those which cannot be safely performed while the equipment is in service.

12. Infrared tests are intended to show excessive heating locations while the equipment is energized and under near maximum load conditions. It is recommended that the first infrared test be performed while the equipment is still under warranty (refer to the following pages).

13. Maintenance of vital Electrical Apparatus must be scheduled along with planned production outages for those tests, inspections, and maintenance items, which cannot be accomplished with the equipment in service.

14. In the third year of operation, a thorough inspection should be made on all electrical distribution equipment. The primary distribution equipment and the 480 volt substation should be de-energized and temporarily taken out of service to perform the necessary tests and maintenance. Careful planning, along with the use of the emergency generator, main and bus tie

breakers, transfer switches, and alternate power sources should minimize the amount of equipment that requires shutdown at any given time.

15. During such outages the primary distribution and the 480 volt substation can undergo the required periodic maintenance and testing. Other, less encompassing, tests and maintenance is required on a more frequent basis and may be accomplished while the equipment remains in service. (Refer to the tabulation). Testing and maintenance, especially while the equipment is energized, should be performed by the more experienced personnel and should be carried out using strict safety procedures.

16. The service shall be performed by a certified, independent testing firm for periodic testing that requires special or accurate test equipment or is beyond the capabilities or time constraints of the normal maintenance personnel.

17. Whenever possible the electrical equipment manufacturers or suppliers maintenance and testing recommendations should be followed. Additional information is available in NFPA Standard 70B “Recommended practice for Electrical Equipment Maintenance”.

8.1 15kv Metal-Enclosed Switches

A. After the third year of operation, and every three years thereafter:

1. De-energize the equipment and take the necessary safety precautions.
2. Perform a complete visual and mechanical inspection (make corrections as necessary).
3. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
4. Check mechanical connections, and mounting or anchorage.
5. Check tightness of accessible bolted electrical connections using calibrated torque wrench.
6. Operate switch several times to verify blade alignment, penetration etc.
7. Inspect contacts for pitting or badly burned surfaces.
8. Inspect insulators for physical damage or contaminated surfaces.
9. Inspect flexible braids for damage.
10. Inspect doors and hinges.
11. Thoroughly clean the entire unit.
12. Lubricate moving parts
13. Apply contact lubricant on the necessary current carrying parts.

14. Perform electrical tests.
15. Check integrity of enclosure grounds by measurement.
16. Check integrity of apparatus grounds by measurement.
17. Perform insulation resistance tests on each pole, phase to phase, and phase to ground. Test voltages shall be in accordance with manufacturer's published data.
18. Measure and record contact resistance across each switch blade and fuse holder.
19. Measure and record fuse resistance.

B. Annually

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
2. Check and record fuse sizes and compare with the latest drawings.
3. Perform a thermographic survey (infrared test) with the equipment supplying its normal load.
4. Measure and record phase currents using a clamp on type ammeter.

C. Quarterly

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
2. Check space heater operation.

D. Weekly

1. Record local meter readings, if available. The meter recordings shall include kWh and maximum kW demand, ammeter readings and demand for each phase and phase voltages (both line to line and line to neutral if applicable). The kW demand and ammeter demand indicators shall be reset after each weekly reading.

8.2 Transformer (Liquid Filled Medium Voltage)

A. After the third year of operation, and every three years thereafter:

1. De-energize the equipment and take the necessary safety precautions.
2. Perform a complete visual and mechanical inspection (make corrections as necessary).

3. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
4. Check mechanical connections, and mounting or anchorage.
5. Check tightness of accessible bolted electrical connections with calibrated torque wrench.
6. Inspect insulators/bushings for physical damage or contaminated surfaces.
7. Inspect doors and hinges.
8. Thoroughly clean any compartments in the unit.
9. Verify correct liquid levels.
10. Perform electrical tests.
11. Check integrity of enclosure grounds by measurement.
12. Check neutral grounds by measurement.
13. Check neutral for multiple grounds.
14. Perform insulation resistance tests, winding to winding, and each winding to ground. Test voltages shall be in accordance with manufacturer's published data.
15. Calculate polarization index.
16. Measure and record winding resistance.
17. Perform a dissipation factor test (Doble) on all 12.4kV windings and bushings.
18. Perform a turns ratio test
19. Test Surge Arresters

B. Annually

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
2. Perform a thermographic survey (infrared test) with the equipment supplying its normal load.
3. Measure and record phase and neutral currents using a clamp on type ammeter.

4. Take an oil sample and send it out for analysis. Tests to include combustible gas content, PCB content, moisture content and dielectric strength.

C. Quarterly

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
2. Check space heater operation.
3. Check alarm settings
4. Check cooling system operation.

D. Weekly

1. Record local meter readings, if available. The meter recordings shall include kWh and maximum kW demand, ammeter readings and demand for each phase and phase voltages (both line to line and line to neutral if applicable). The kW demand and ammeter demand indicators shall be reset after each weekly reading
2. Check cooling system operation.

8.3 Transformer (Dry Type)

A. After the third year of operation, and every three years thereafter:

1. De-energize the equipment and take the necessary safety precautions.
2. Perform a complete visual and mechanical inspection (make corrections as necessary).
3. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
4. Check mechanical connections, and mounting or anchorage.
5. Check tightness of accessible bolted electrical connections using a calibrated torque wrench.
6. Inspect insulators/bushings for physical damage or contaminated surfaces.
7. Inspect doors and hinges.
8. Thoroughly clean any compartments in the unit.
9. Perform electrical tests.
10. Check integrity of enclosure grounds by measurement.

11. Check neutral grounds by measurement
12. Check neutral for multiple ground connections.
13. Perform insulation resistance tests winding to winding, and each winding to ground. Test voltages to be in accordance with manufacturer's published data.
14. Calculate polarization index.
15. Measure and record winding resistance.
16. Perform a turns ratio test
17. Test Surge Arresters

B. Annually

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
2. Perform a thermographic survey (infrared test) with the equipment supplying its normal load.
3. Measure and record phase and neutral currents using a clamp on type ammeter.

C. Quarterly

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
2. Check space heater operation.
3. Check alarm settings
4. Check cooling system operation.

D. Weekly

1. Record local meter readings, if available. The meter recordings shall include kWh and maximum kW demand, ammeter readings and demand for each phase and phase voltages (both line to line and line to neutral if applicable). The kW demand and ammeter demand indicators shall be reset after each weekly reading
2. Check the outside of the equipment for anything unusual.
3. Check cooling system operation.

8.4 480 Volt Switchgear

A. After the third year of operation, and every three years thereafter:

1. De-energize the equipment and take the necessary safety precautions.
2. Perform a complete visual and mechanical inspection (make corrections as necessary).
3. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
4. Check mechanical connections, and mounting or anchorage.
5. Check tightness of accessible bolted electrical connections.
6. Check tightness of cable connections.
7. Inspect insulators, bushings, barriers etc. for physical damage or contaminated surfaces.
8. Inspect doors and hinges.
9. Thoroughly clean all compartments in the unit.
10. Perform electrical tests.
11. Check enclosure grounds.
12. Check neutral grounds.
13. Perform insulation resistance tests
14. Test control circuit operation
15. Check alarms
16. Perform Circuit Breaker maintenance
17. Calibrate and test relays (remove if necessary)
18. Calibrate and test meters (remove if necessary)
19. Perform other appropriate annual, quarterly, monthly and weekly tests.

B. Annually

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
2. Perform a thermographic survey (infrared test) with the equipment supplying its normal load.

3. Measure and record phase and neutral currents using a clamp on type ammeter.

4. Check enclosure grounding by measurement.

C. Quarterly

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.

2. Check space heater operation.

D. Weekly

1. Record local meter readings, if available. The meter recordings shall include kWh and maximum kW demand, ammeter readings and demand for each phase and phase voltages (both line to line and line to neutral if applicable). The kW demand and ammeter demand indicators shall be reset after each weekly reading

8.5 Power Panels

A. After the third year of operation, and every three years thereafter:

1. De-energize the equipment and take the necessary safety precautions.

2. Perform a complete visual and mechanical inspection (make corrections as necessary).

3. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.

4. Check mechanical connections, and mounting or anchorage.

5. Check tightness of accessible bolted electrical connections with calibrated torque wrench

6. Check tightness of cable connections.

7. Inspect insulators, barriers etc. for physical damage or contaminated surfaces.

8. Inspect doors and hinges.

9. Thoroughly clean all compartments in the unit.

10. Perform electrical tests.

11. Check enclosure grounds.

12. Check neutral grounds.

13. Perform insulation resistance tests
14. Check alarms
15. Inspect and operate molded case breakers.
16. Calibrate and test relays.
17. Calibrate and test meters
18. Perform other appropriate annual, quarterly, monthly and weekly tests.

B. Annually

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
2. Perform a thermographic survey (infrared test) with the equipment supplying its normal load.
3. Measure and record phase and neutral currents using a clamp on type ammeter.
4. Check enclosure grounding by measurement.

C. Quarterly

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
2. Check space heater operation.

D. Weekly

1. Record local meter readings, if available. The meter recordings shall include kWh and maximum kW demand, ammeter readings and demand for each phase and phase voltages (both line to line and line to neutral if applicable). The kW demand and ammeter demand indicators shall be reset after each weekly reading.

8.6 Motor Control Centers

A. After the third year of operation, and every three years thereafter.

1. De-energize the equipment and take the necessary safety precautions.
2. Perform a complete visual and mechanical inspection (make corrections as necessary).
3. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear,

chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.

4. Check mechanical connections, and mounting or anchorage.
5. Check tightness of accessible bolted electrical connections using calibrated torque wrench.
6. Check tightness of cable connections.
7. Inspect insulators, barriers etc. for physical damage or contaminated surfaces.
8. Inspect doors and hinges.
9. Thoroughly clean all compartments in the unit.
10. Perform electrical tests.
11. Check enclosure grounds by measurement.
12. Check neutral grounds by measurement.
13. Perform insulation resistance tests in accordance with manufacturers published data.
14. Check alarms and set points.
15. Check and record motor sizes
16. Check and record overload sizes.
17. Inspect and operate molded case breakers,
18. Remove, calibrate and test relays.
19. Remove calibrate and test meters

B. Annually

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
2. Perform a thermographic survey (infrared test) with the equipment supplying its normal load.
3. Measure and record phase and neutral currents using a clamp on type ammeter.
4. Check enclosure grounding.

C. Quarterly

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for moisture, signs of previous wetness, dirt,

excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.

2. Check space heater operation.

D. Weekly

1. Record local meter readings, if available. The meter recordings shall include kWh and maximum kW demand, ammeter readings and demand for each phase and phase voltages (both line to line and line to neutral if applicable). The kW demand and ammeter demand indicators shall be reset after each weekly reading

8.7 Transfer Switches

A. After the third year of operation, and every three years thereafter:

1. De-energize the equipment and take the necessary safety precautions.
2. Perform a complete visual and mechanical inspection (make corrections as necessary).
3. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
4. Check mechanical connections, and mounting or anchorage.
5. Check tightness of accessible bolted electrical connections using a calibrated torque wrench.
6. Check tightness of cable connections.
7. Inspect insulators, barriers etc. for physical damage or contaminated surfaces.
8. Inspect doors and hinges.
9. Thoroughly clean all compartments in the unit.
10. Lubricate moving parts if appropriate.
11. Perform electrical tests.
12. Check enclosure grounds.
13. Check neutral grounds.
14. Perform insulation resistance tests
15. Check alarms
16. Inspect and operate switch several times to assure proper operation.
17. Test and record contact resistance.

18. Remove, calibrate and test relays.
19. Remove calibrate and test meters

B. Annually

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
2. Perform a thermographic survey (infrared test) with the equipment supplying its normal load.
3. Measure and record phase and neutral currents using a clamp on type ammeter.
4. Check enclosure grounding.
5. Quarterly
6. Perform visual inspections that may be accomplished safely with the equipment in service. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
7. Check space heater operation.

C. Weekly

1. Record local meter readings, if available. The meter recordings shall include kWh and maximum kW demand, ammeter readings and demand for each phase and phase voltages (both line to line and line to neutral if applicable). The kW demand and ammeter demand indicators shall be reset after each weekly reading.

8.8 UPS System

A. After the third year of operation, and every three years thereafter:

1. De-energize the equipment and take the necessary safety precautions.
2. Perform a complete visual and mechanical inspection (make corrections as necessary).
3. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
4. Check mechanical connections, and mounting or anchorage.

5. Check tightness of accessible bolted electrical connections using a calibrated torque wrench.
6. Check tightness of cable connections.
7. Inspect insulators, barriers etc. for physical damage or contaminated surfaces.
8. Inspect doors and hinges.
9. Thoroughly clean all compartments in the unit.
10. Lubricate moving parts if appropriate.
11. Perform electrical tests.
12. Check enclosure grounds.
13. Check neutral grounds.
14. Perform insulation resistance tests
15. Test alarms
16. Functionally test system operation.
17. Test and record contact resistances.
18. Remove, calibrate and test relays.
19. Remove, calibrate and test meters.
20. Test individual components as specified under component types.

B. Annually

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
2. Perform a functional system load test.
3. Perform a thermographic survey (infrared test) with the equipment supplying its normal load.
4. Measure and record phase and neutral currents using a clamp on type ammeter with the system normal and then with the system in by-pass.
5. Check enclosures grounding by measurement.

C. Quarterly

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration),

excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.

2. Check space heater operation.

D. Weekly

1. Record local meter readings, if available. The meter recordings shall include kWh and maximum kW demand, ammeter readings and demand for each phase and phase voltages (both line to line and line to neutral if applicable). The kW demand and ammeter demand indicators shall be reset after each weekly reading.

8.9 Battery Charger

A. After the third year of operation, and every three years thereafter:

1. De-energize the equipment and take the necessary safety precautions.
2. Perform a complete visual and mechanical inspection (make corrections as necessary).
3. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
4. Check mechanical connections, and mounting or anchorage.
5. Check tightness of accessible bolted electrical connections using a calibrated torque wrench.
6. Check tightness of cable connections.
7. Inspect insulators, barriers etc. for physical damage or contaminated surfaces.
8. Inspect doors and hinges.
9. Thoroughly clean all compartments in the unit.
10. Lubricate moving parts if appropriate.
11. Perform electrical tests.
12. Check enclosure grounds.
13. Check neutral grounds.
14. Perform insulation resistance tests
15. Check alarms
16. Inspect and operate switch several times to assure proper operation.
17. Test and record contact resistance.
18. Remove, calibrate and test relays.

19. Remove calibrate and test meters

B. Annually

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
2. Perform a thermographic survey (infrared test) with the equipment supplying its normal load.
3. Measure and record phase and neutral currents using a clamp on type ammeter.
4. Check enclosure grounding.

C. Quarterly

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
2. Check space heater operation.

D. Weekly

1. Record local meter readings, if available. The meter recordings shall include kWh and maximum kW demand, ammeter readings and demand for each phase and phase voltages (both line to line and line to neutral if applicable). The kW demand and ammeter demand indicators shall be reset after each weekly reading.

8.10 Battery

A. After the third year of operation, and every three years thereafter:

1. Perform a complete visual and mechanical inspection (make corrections as necessary).
2. Check Batteries for leaks, terminal corrosion, physical damage, contamination, dirt, signs of excessive heat (discoloration).
3. Check room or enclosure ventilation.
4. Check mechanical connections, and mounting or anchorage.
5. Check tightness of accessible bolted electrical connections using a calibrated torque wrench.
6. Check tightness of cable connections.
7. Inspect doors and hinges (if applicable)

8. Thoroughly clean all battery surfaces and terminals if required.
9. Thoroughly clean the battery room or enclosure.
10. Perform electrical tests.
11. Check enclosure or rack grounds.
12. Perform insulation resistance tests on cables
13. Perform resistance measurements through all accessible bolted connections with a low resistance ohmmeter.
14. Check alarms and set points
15. Test and record terminal contact resistance.
16. Measure and record individual cell voltages.

B. Annually

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for moisture, signs of leaks, dirt, excessive dust or contamination, signs of excessive heat (discoloration). Check for adequate ventilation of room or enclosure.
2. Perform a thermographic survey (infrared test) with the equipment supplying its normal load.
3. Measure and record cell voltages.
4. Measure load currents using a clamp on type ammeter.
5. Check enclosure or rack grounding.

C. Quarterly

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for moisture, signs of leaks, dirt, excessive dust or contamination, signs of excessive heat (discoloration).
2. Check for adequate ventilation of room or enclosure.
3. Test electrolyte of each cell.

D. Weekly

1. Record local meter readings, if available. Ammeter demand indicators if available shall be reset after each weekly reading.

8.11 Emergency Generator (480 Volt)

A. After the third year of operation, and every three years thereafter:

1. De-energize the equipment and take the necessary safety precautions. (The prime mover is not addressed in these procedures.)
2. Perform a complete visual and mechanical inspection (make corrections as necessary).

3. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
4. Check mechanical connections, and mounting or anchorage.
5. Check tightness of accessible bolted electrical connections using a calibrated torque wrench.
6. Check tightness of cable connections.
7. Inspect insulators, bushings, barriers etc. for physical damage or contaminated surfaces.
8. Inspect all doors and hinges.
9. Thoroughly clean all compartments in the unit.
10. Perform electrical tests.
11. Check enclosure grounds by measurement.
12. Check neutral grounds by measurement.
13. Perform insulation resistance tests on generator windings.
14. Calculate polarization index
15. Test control circuit operation and shutdowns.
16. Verify functions of the governor.
17. Verify functions of the regulator.
18. Check alarms and setpoints.
19. Check starting battery voltages.
20. Perform Circuit Breaker maintenance
21. Calibrate and test relays.
22. Calibrate and test meters

B. Annually

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
2. Perform a thermographic survey (infrared test) with the equipment supplying a substantial (50%) load.
3. Measure and record phase and neutral currents using a clamp on type ammeter.

4. Check enclosure grounding.
5. Check batteries and engine starting system.

C. Quarterly

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
2. Check space heater operation.
3. Verify jacket water heater operation

D. Monthly

1. Record local meter readings, if available. The meter recordings shall include kWh and maximum kW demand, ammeter readings and demand for each phase and phase voltages (both line to line and line to neutral if applicable). The kW demand and ammeter demand indicators shall be reset after each monthly reading.
2. Perform functional load test in accordance with NFPA 110 monthly, or the interval recommended by the manufacturer; adhering to the more frequent test interval.
3. Check air circulation and air flow paths.

8.12 Variable Speed Drives (VSD)

A. After the third year of operation, and every three years thereafter:

1. De-energize the equipment and take the necessary safety precautions.
2. Perform a complete visual and mechanical inspection (make corrections as necessary).
3. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
4. Check mechanical connections, and mounting or anchorage.
5. Check tightness of accessible bolted electrical connections.
6. Check tightness of cable connections.
7. Inspect insulators, barriers etc. for physical damage or contaminated surfaces.
8. Inspect doors and hinges.
9. Thoroughly clean all compartments in the unit.

10. Lubricate moving parts if appropriate.
11. Perform electrical tests.
12. Check enclosure grounds.
13. Perform insulation resistance tests
14. Check alarms and set points.
15. Test and record contact resistance (if applicable)
16. Calibrate and test relays.
17. Calibrate and test meters
18. Check speed signals.

B. Annually

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
2. Perform a thermographic survey (infrared test) with the equipment supplying its normal load.
3. Measure and record phase currents using a clamp on type ammeter.
4. Measure and record harmonic content.
5. Check enclosure grounding.

C. Quarterly

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for moisture, signs of previous wetness, dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, peeling cracking, pitting, infestation, adequate ventilation, accuracy of position indicators, etc.
2. Check space heater operation.

D. Weekly

1. Record local meter readings, if available. The meter recordings shall include speed, kWh and maximum kW demand, ammeter readings and demand for each phase and phase voltages (both line to line and line to neutral if applicable). The kW demand and ammeter demand indicators shall be reset after each weekly reading.

8.13 Circuit Breakers

A. After the third year of operation, and every three years thereafter:

1. The availability of a few spare circuit breakers of the various types would help minimize the down time of equipment by allowing a change while repairs or testing is performed.
2. Perform a complete visual and mechanical inspection (performing maintenance or repairs as necessary).
3. Inspect insulators, barriers etc. for physical damage or contaminated surfaces.
4. Check tightness of accessible bolted electrical connections.
5. Check tightness of cable or wire connections.
6. Check contact surfaces for pitting, excessive wear or damage.
7. Check contact alignment and pressure
8. Thoroughly clean all components in the unit.
9. Clean contacts and contact surfaces.
10. Inspect and clean arc interrupters
11. Lubricate moving parts if appropriate.
12. Lubricate contacts and contact surfaces with contact lubricant
13. Perform electrical tests.
14. Check ground contact.
15. Perform insulation resistance tests
16. Perform resistance measurements through all accessible bolted connections with a low resistance ohmmeter.
17. Test and record contact resistance.
18. Perform opening and closing operations
19. Test electrical and manual operation
20. Check breaker position indicators
21. Check auxiliary contact operation

B. Annually

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, cracking, pitting, accuracy of position indicators, etc.

2. Perform a thermographic survey (infrared test) with the equipment supplying its normal load.

8.14 Motor Starters

A. After the third year of operation, and every three years thereafter:

1. The availability of a few spare starters of the various types would help minimize the down time of equipment by allowing a change while repairs or testing is performed.
2. Perform a complete visual and mechanical inspection (performing maintenance or repairs as necessary).
3. Inspect insulators, barriers etc. for physical damage or contaminated surfaces.
4. Check tightness of accessible bolted electrical connections.
5. Check tightness of cable or wire connections.
6. Check contact surfaces for pitting, excessive wear or damage.
7. Thoroughly clean all components in the unit.
8. Clean contacts and contact surfaces.
9. Lubricate moving parts if appropriate.
10. Lubricate contacts and contact surfaces with contact lubricant
11. Perform electrical tests.
12. Check ground contact.
13. Perform insulation resistance tests
14. Perform resistance measurements through all accessible bolted connections with a low resistance ohmmeter.
15. Test and record contact resistance for breaker and contactor.
16. Perform breaker and contactor opening and closing operations
17. Test electrical control operation
18. Perform electrical protection tests.
19. Check auxiliary contact operation

B. Annually

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for dirt, excessive dust or contamination, signs of excessive heat (discoloration), excessive wear, chipping, cracking, pitting, accuracy of position indicators, etc.
2. Perform a thermographic survey (infrared test) with the equipment supplying its normal load.

8.15 Protective Relays

A. After the third year of operation, and every three years thereafter:

1. Perform a complete visual and mechanical inspection (performing maintenance or repairs as necessary).
2. Inspect relays and cases for physical damage
3. Check tightness of electrical connections.
4. Verify relay settings.
5. Clean devices.
6. If disc type, inspect disc and verify freedom of movement.
7. Check contact surfaces and alignment.
8. Perform electrical tests.
9. Check ground contact.
10. Perform insulation resistance tests (check with vendor for solid state)
11. Inspect targets and indicators.
12. Perform electrical protection tests.
13. Check auxiliary contact operation

B. Annually

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for dirt, excessive dust or contamination, signs of damage, etc.
2. Verify settings

8.16 Meters And Power Monitors

A. After the third year of operation, and every three years thereafter:

1. Perform a complete visual and mechanical inspection (performing maintenance or repairs as necessary).
2. Inspect meters and cases for physical damage
3. Check tightness of electrical connections.
4. Clean devices
5. Perform electrical tests.
6. Test and calibrate meters Perform other appropriate annual tests.
7. Verify alarm settings (if any).

B. Annually

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for dirt, excessive dust or contamination, signs of damage, etc.
2. Verify settings
3. Record maximum and minimum demand values, then reset.

8.17 Surge Protection Devices

A. After the third year of operation, and every three years thereafter:

1. Perform a complete visual and mechanical inspection (performing maintenance or repairs as necessary).
2. Inspect for physical damage
3. Check tightness of electrical connections.
4. Clean devices
5. Perform electrical tests.
6. Insulation resistance test.
7. Test grounding.

B. Annually

1. Perform visual inspections that may be accomplished safely with the equipment in service. Check for dirt, excessive dust or contamination, signs of damage, etc.
2. Perform infrared test.

8.18 Grounding

A. After the third year of operation, and every three years thereafter:

1. Perform a complete visual and mechanical inspection (performing maintenance or repairs as necessary).
2. Inspect exposed conductors and devices for physical damage or excessive corrosion.
3. Check tightness of electrical connections.
4. Perform electrical tests.
5. Test grounding resistance in accordance with IEEE 81 compare values with original test results.

B. Annually

1. Inspect exposed conductors and devices for physical damage or excessive corrosion.

2. Check tightness of electrical connections.

8.19 Lightning Protection

A. After the third year of operation, and every three years thereafter:

1. Perform a complete visual and mechanical inspection (performing maintenance or repairs as necessary).
2. Inspect for physical damage
3. Check tightness of electrical connections.
4. Perform electrical tests.
5. Measure and record air terminal resistance
6. Test grounding connections to ground grid at perimeter of building.

B. Annually

1. Perform visual inspections for physical damage.
2. Check tightness of electrical connections.

8.20 Cables

A. Cables shall be visually inspected, insulation tested, and the terminations infrared tested at the same times the connected equipment is tested.

B. After the third year of operation, and every three years thereafter:

1. Perform a complete visual and mechanical inspection (performing maintenance or repairs as necessary).
2. Inspect for physical damage
3. Check tightness of electrical connections.
4. Perform electrical tests.
5. Measure and record insulation resistance.

C. Annually

1. Perform visual inspections for physical damage.
2. Infrared test

8.21 Heat Tracing

A. Weekly checks should be scheduled during freeze periods.

B. Annually (before winter)

1. Perform visual inspections for physical damage.
2. Check tightness of electrical connections.
3. Perform continuity checks
4. Check controller and thermostat operation.

8.22 Public Address System

A. Testing of the PA system is an ongoing event through daily usage.

B. Annually

1. Perform visual inspections for physical damage.
2. Perform transmit and receive tests at each station.

8.23 Lighting

A. Testing of the Lighting system is an ongoing event through daily usage and observations.

B. Annually

1. Perform visual inspections for burnt out or low luster lamps, physical damage, etc and make repairs or relamp accordingly.
2. Test Lighting Control System and perform visual inspections.

8.24 Lighting Control

A. Automatic lighting is controlled through the Building Management System (BMS) testing of the Lighting Control system is an ongoing event through daily usage.

B. Annually

1. Test the operation and control via the BMS system and perform visual inspections accordingly.

8.25 Emergency Lighting

A. Annually

1. Check operation of emergency and life safety lighting for 90 minutes. Replace any defective ballasts, batteries, lamps, or fixtures accordingly.

B. Monthly

1. Check operation of emergency and life safety lighting for 30 seconds. Replace any defective ballasts, batteries, lamps, or fixtures accordingly.

CHAPTER 9

VOLUME 7 OPERATION AND MAINTENANCE REQUIREMENTS

Operation and Maintenance Statement of Work

Specialty Systems

Table of Contents

9.0 Specialty Systems - General Information

A. General Description

1. The O&M Statement of Work is intended to outline the preventive maintenance for each System and their respective subsystems contained in the building. It is intended to be the continuation of the development of a comprehensive operation and maintenance program description that began during design and will be further defined during construction with the completion of the Management Plan & Systems Operation Maintenance Manual.

2. All information contained within this volume shall be done under the Preventive Maintenance and Minor Repair facet of the Operation and Maintenance portion of this contract. For other scope of work required for systems and equipment noted in this chapter see Chapter 1 – Statement of Work.

3. As more detailed information is obtained during construction with submittal approval and detailed management procedures, the manual will evolve to a detailed and specific scope of work. Information will be further developed and updated in the Management Plan & Systems Operation and Maintenance manual during the five years following construction completion.

4. This chapter is not intended to replace other contract documents, shop drawings, as-built drawings, or equipment manufacturers' instructions; instead, the intent is to supplement such documents and provide a guide to the specific scope of work required by system and equipment. It is intended to augment the understanding of the functioning of each system.

5. The periodic maintenance schedule outlined in this section represents the minimal essential preventive maintenance actions.

   a. The Contractor should consult Manufacturer's documentation for each specific item to supplement this information.

   b. In cases where Manufacturer's data conflicts with the periodic maintenance data in this chapter, the Contractor should follow the Manufacturer's recommendations and update this manual to reflect those changes.

B. Related Information

1. Chapter 1 of this manual details the management systems and defines additional scope required that will facilitate the execution of this comprehensive program. For information linking this section into the overall operation and maintenance program see the following related sections.

a. VOLUME 7 - Operation and Maintenance Statement of Work (O&M SOW)

b. Appendix A – Management Plan & Systems Operation and Maintenance Manual Templates

c. Drawings and Specifications, especially Specification Section 01700, Operation and Maintenance Data

d. Equipment Manufacturers' Instructions

A. General Scope of Work

1. The Contractor shall be responsible for the operation, PM, and testing of all specialty systems in accordance with manufacturers' O&M instructions and applicable NFPA Standards.

C. General Work Practices

1. At the outset of all maintenance described herein, the servicing contractor shall follow appropriate accepted practices and applicable codes (e.g. NFPA, OSHA, etc.) for maintenance personnel protection.

2. Servicing Contractors shall utilize appropriate means, methods, and instruments for servicing all equipment listed herein; e.g., contractor shall verify the use of proper/approved system lubricant, application method, and application quantity. Procurement of said instruments shall be the responsibility of the Service Contractor.

B. All preventive maintenance work listed in this document (either written or implied) shall be performed as to not void any equipment warranties of this facility. All maintenance data listed for each piece of mechanical equipment shall be done, in their entirety, at dates of coinciding maintenance requirements, i.e. monthly maintenance shall not be foregone during times of Bi-annual maintenance.

9.1 Projection Screens

A. Annually

1. Check that the projection screen housing is secured to the ceiling or structure above. Tighten support rods if necessary.

2. Check that the ceiling closure operates correctly.

3. Run the screen through several cycles to determine that the control switch functions properly.

4. While the screen is in the down position, check for wrinkles, waves, or other indications that the tensioning cable needs adjustment. Adjust in accordance with manufacturer's instructions.

5. Check the screen surface for stains. If required, clean with a very soft brush or cloth and carefully dust the surface. Do not clean with soap, water, or solvents.

9.2 Toilet Partitions and Hardware

A. Annually

1. Check wall brackets, shoes, overhead braces, and fasteners are in place and secure.
2. Check door operation and door hardware. Doors should rest open at approximately 30 degrees. Adjust as required.
3. Replace panels and hardware that are beyond repair.

9.3 Cubicle Curtains and Tracks

A. Annually

1. Check the track and remove dust and dirt if necessary.
2. Check the carrier units and verify that all hooks are in place and in good condition.
3. Check that all fasteners are secure.
4. Check the curtains for tears, missing grommets, loose seams and hems. Recommend repair as required.
5. If the curtains are soiled or dusty, remove from the hangers, clean in accordance with manufacturer's recommendations, and reinstall the curtains.

9.4 Raised Floor

A. Annually

1. Rotate the floor panels from high traffic areas to low traffic areas to spread the wear evenly over the entire floor.
2. Check pedestals and other types of supports for possible damage or movement. Repair as required.
3. While the panels are removed, completely clean the concrete surface under the raised floor with HEPA type vacuum cleaner.
4. Verify that underfloor electrical boxes and connections are secure and in good condition.
5. Check grounding connections and secure as required.
6. Check condition of perforated panels and ensure that openings are clear. Clean or repair as required.

7. Check the floor finish for spot stains and excessive wear. Replace as required under the minor repair guidelines. Check resilient base and reattached loose areas if applicable.

9.5 Signage

A. Annually

1. Check that individual letters and plaques are securely attached to substrate.
2. Check exterior post and panel signs for delamination and contact manufacturer for repairs.
3. Check interior signs for missing inserts and recommend replacement as needed. Reattach loose or missing signs.
4. Check directories and recommend repair as needed.

9.6 Steel Clothing Lockers

A. Annually

1. Tighten loose hardware on body and hooks.
2. Tighten loose hardware on handle assembly.
3. Adjust door jambs on frame member if door does not latch properly. Adjust downward if door hangs up and upward if door fails to latch.
4. Straighten lockbar pins in door channel if bent.
5. Touchup scratches with air-dry paint available from the manufacturer.

9.7 Metal Canopies

A. Bi-Annually

1. Check gutters and drainage system for accumulation of leaves and debris. Remove as required.
2. Repair or replace cracked sealants as required.
3. Verify that wall flashing is secure and not leaking. Repair as required under the minor repair revisions.
4. Wash exposed metal surfaces with low-pressure water and mild detergent.

9.8 Operable Panel Partitions

A. The partition system should be periodically checked for damage and repaired as necessary. An authorized panel partition manufacturer should make adjustments as necessary.

B. After the first and third year and before the completion of the fifth year of the O&M phase of the contract:

1. Check panel vertical edges for plumb and adjusted as necessary.

2. Check the track for proper leveling and readjust as necessary.
3. Check lever closure and adjust as needed.
4. Operate pass door and adjust as needed.
5. Check for torn vinyl or fabric and repair or replace as needed.

C. Annually

1. Clean and inspect the track. Apply a coat of petroleum jelly to the entire surface on which the carriers run.
2. Check track misalignment at all joints and intersections. Correct misalignments as needed.
3. Check top sweep contact surfaces. Check all soffit and surfaces in contact with the top sweeps for wear or rough spots. Adjust the panels as necessary to bring the sweep back into position.
4. Check the panels for damage and soiled spots. Repair as required under the minor repair provisions. Clean as necessary in accordance with manufacturer's recommendations.

9.9 Mobile Storage System

A. Annually

1. Check the condition of the rail. Remove foreign material and debris from the top of the track and the guide bearing by vacuuming.
2. After cleaning, apply silicon or Teflon spray to the top rails.
3. Check the condition of the handle and the chain tension. Tighten as required. Rotate each revolving knob of the handles and look for smooth travel.
4. Check the condition of the drive train. Look for solid connection of all axles, couplers, drive shafts, and sprockets. Inspect and tighten all screws.
5. Look for missing woodruff keys. Check the synchro drive wheel section's chain tension and adjust if loose. Lightly lubricate the drive chain.
6. Check the condition of the anti-tip device. Check that all required hooks are in place and secure. Look for binding or jerky travel of the carriage. Check the tube and saddles for signs of wear.
7. Check the condition of the roller guide brackets in accordance with the manufacturer's recommendations. Check the guide bearings. Replace any that are missing, realign and tighten and that are loose.
8. Check the condition of the carriage bumpers and end stops. Replace missing or damaged bumpers.

9. Check the condition of all fasteners and hardware. Secure face and end panels. Replace any missing hardware and add hardware you feel is necessary for smooth system operation and safety.
10. Check the condition of all cables and boxes, following the manufacturer's checklist in the Owner's Manual.
11. Check the condition of the safety devices. Actuate each of the safety devices built into the system.
12. Operate each carriage in both directions and look, listen, and feel for smooth travel. Any unusual sounds or vibrations should be investigated.
13. Check the finished floor covering and make sure it does not interfere with carriage movement or function. Secure loose flooring as required.
14. Clean the laminate panels as required with recommended cleaner.
15. Check condition of painted surfaces and clean soiled surfaces as required.

9.10 Toilet Accessories

A. For the following items, inspect the equipment for wear, broken or loose parts, and finish condition. Repair as required.

B. Electric Hand Dryers:

1. Annually
    a. Clean dryers to remove lint, etc. from the fan and other parts of the dryer.
    b. Inspect motor brushes for wear and replace if less than 1/4-inch remaining.

C. Grab Bars:

1. Annually
    a. Check that grab bars are secure and all fasteners and cover plates are in place.
    b. Replace grab bars that are bent or broken.

D. Mirrors:

1. Annually
    a. Check that mirrors are plumb and secured to the walls as required.
    b. Replace scratched or broken mirrors as required.

E. Soap Dispensers:

1. Monthly
    a. Check for proper operation. Repair or replace as required.

9.11 Refrigerators/Icemaker

A. Bi-Annually

1. Clean condenser coils.
2. Check light bulbs in the refrigerator, freezer, and icemaker and replace as required.

9.12 Microwave Hood Combination

A. Bi-Annually

1. Check the condition of the filters and clean as required. Recommend replacement of filters that are heavily soiled and otherwise cannot be cleaned.
2. Check the operation of the blower speeds.
3. Check the light bulb and replace as required.

9.13 Trash Compactor

A. Bi-Annually

1. Check the condition of the air filter and replace as required.
2. Clean the interior of the compactor with warm, sudsy water and damp cloth. Dry with soft cloth.
3. Check condition of drawer tracks and rollers. Tighten loose parts as required.
4. With the drawer pulled out, vacuum inside the compartment and around the base of the cabinet.
5. Check the condition of the lock mechanism and tighten as required. If mechanism does not latch, consult manufacturer for repairs or replacement parts.

9.14 Dishwasher

A. Annually

1. Check the condition of the drain air gap for soil build up. Clean if necessary.
2. Check for white film build up on the inside surfaces due to hard water minerals. Clean with dishwashing soap and a damp cloth. Run a normal cycle with detergent after cleaning.

9.15 Range

A. Annually

1. Check the operation of the oven and the cooktop.
2. Check circuit breakers and reset if necessary.

3. Check oven light and replace if necessary.
4. Check the condition of the oven to warrant self-cleaning cycle.
5. Before starting the self-cleaning cycle, check the condition of the gaskets. Clean by hand washing, as recommended by the manufacturer.

9.16 Darkroom Cabinets and Countertops

A. Annually

1. Check for scratches, remove with light sanding, and buff entire area using an electric drill with cotton buffing wheel.
2. Repair loose laminate and seams with epoxy adhesive.
3. Apply a heavy paste wax and polish.
4. Within six months of initial operation, check all hardware, screws, bolts and nuts and tighten as required. Thereafter, examine all mechanical attaching devices on an annual basis.
5. Lubricate drawers and sliding doors. Apply a small drop of fine oil to all hinges.

9.17 Darkroom Stainless Steel Sinks

A. Annually

1. Check for rust spots and clean as necessary following the manufacturer's recommendations.
2. Check the seal between the tub and sink plug for leaks. Repair as required.
3. Check vacuum breakers for leaks or caused by worn or scored gaskets. Replace gaskets as necessary.
4. Check internal parts for foreign material that could prevent proper seating. Clean as necessary.
5. Check dial thermometer for proper calibration.
6. Check thermostatic control valves for proper function. Follow manufacturer's instructions for inspection and cleaning. Check the thermostat, piston, and hot water liner.
7. Check the mixing valve for proper setting of handle no. 1, test cold shut off, and test hot shut off. Follow manufacturer's instructions.
8. Check inline water filters and replace as necessary. Depending on quality of water source, filters should be checked at least twice a year.

9.18 Safelights

1. Replace lamp and filters during the fourth year of the O&M phase of the contract.

B. Every 2 years

1. Check lamp for signs of flickering, and examine filters for any deterioration. Replace as necessary.

9.19 Tray Processing Sinks

A. Annually

1. Check for rust spots and clean as necessary following the manufacturer’s recommendations.
2. Check the seal between the tub and sink plug for leaks. Repair as required.
3. Check vacuum breakers for leaks or caused by worn or scored gaskets. Replace gaskets as necessary.
4. Check internal parts for foreign material that could prevent proper seating. Clean as necessary.
5. Check dial thermometer for proper calibration.
6. Check thermostatic control valves for proper function. Follow manufacturer’s instructions for inspection and cleaning. Check the thermostat, piston, and hot water liner.
7. Check the mixing valve for proper setting of handle no. 1, test cold shut off, and test hot shut off. Follow manufacturer’s instructions.
8. Check inline water filters and replace as necessary. Depending on quality of water source, filters should be checked at least twice a year.

B. Bi-Monthly

1. Clean the strainer screens to prevent dirt and sediment from entering the adjustable temperature blender.

9.20 Silver Recovery Systems

A. Bi-Annually

1. Replace first cartridge after treating 400 gallons or 250 hours of use.
2. Check the pump flow rate and adjust if necessary.

B. Annually

1. Test the liquid level switch for proper function.
2. After 80 hours of use, and once a year thereafter, take one sample from the holding tank and one sample after cartridge no. 2 and submit to the manufacturer’s testing lab for analysis. The results will verify the performance of the unit.
3. Clean the poppet valve assemblies or discard and replace.

9.21 Acid Neutralization / Dilution Tank

A. Every Two Years

1. Replace limestone chips.

B. Bi-Monthly

1. Check the limestone level in the tank. If the level varies from the manufacturer's specifications, adjust as required following the procedures outlined in the maintenance manual.

9.22 Darkroom Water Control Panels

A. Every two years:

1. Clean the flow meter and replace the top and bottom o-rings.

   a. Replace batteries.

B. Annually

1. Replace filters.
2. Check filter canisters for leaks and correct if necessary.
3. Clean or replace screens and washers.
4. Disassemble the controller and clean or replace the diaphragms, stop block, and washers in the anti-hammer chamber.

C. Bi-Annually

1. Check for signs of leaks in or around the controller or filter panel and repair as needed.

D. Monthly

1. Test the battery backup system monthly. Replace batteries as necessary.

9.23 Bullet Recovery Tank

A. Annually

1. Check the access door for proper operation and condition. Check gaskets, opening and closing mechanism, and safety lights.
2. Verify that exhaust duct connection and fan are in good working condition.
3. Change underwater bulb.
4. Clean or change exhaust filters, and backwash water filters as required.
5. Change water filters.
6. Verify that pumping system operates properly.
7. Drain and clean tank once a year.
8. Check pH and alkalinity at the time the tank is serviced.

9.24 Wet Bullet Trap

A. Bi-Annually

1. Depending on frequency of use, remove the sludge in the reservoir and the front return trough once annually or bi-annually for heavily used ranges.
2. Lower dry ramps: Inspect for dents, gouges, scoring or other signs of wear or misuse.
3. Upper dry ramps: Inspect for dents, gouges, scoring or other signs of wear or misuse.
4. Front return trough: Inspect for wear, buildup, blockage of return pipe, and foreign material. Remove blockage to ensure proper flow of water.
5. Lower wet ramp: Inspect for dents, gouges, scoring or other signs of wear or misuse. Inspect for proper dispersion of fluid across ramp and adjust spraybars if necessary.
6. Upper wet ramp: Inspect for dents, gouges, scoring or other signs of wear or misuse. Inspect for proper dispersion of fluid across ramp.
7. Spraybar: Clear blockage, assure proper alignment, check bolt lockdown, and inspect general flow to maintain proper spray pattern. Adjust if needed.
8. Deflectors: Inspect for sharpness of leading edge, dents, gouges, scoring and wear or misuse to ensure proper alignment and tightness.
9. Trap wall baffles: Inspect for wear and tighten if necessary.
10. Deceleration chamber: Inspect for dents, gouges, scoring or other signs of wear or misuse, both inside and outside.
11. Underneath lower dry ramp: Inspect for erosion of plates, supports, nuts, bolts, and front side of reservoir. Inspect for leakage.
12. Tanks: Inspect pumps, return pipe, perforated trays and tanks for erosion, dents, deterioration, and blockage.
13. Check for tightness of hoses and connections.
    a. Ensure proper positioning of splash guards.
    b. Pump liquid to external container.
    c. Dredge tanks.
    d. Clear inlet pump of debris.
    e. Return fluid to tank.
    f. Check viscosity of solution. If low, add lubricant.
14. Inline filters: Clean and/or replace as needed.
15. Conveyor:

a. Change oil in gearbox.

b. Lubricate primary chain.

c. Adjust conveyor chain.

d. Inspect overall condition of conveyor and notify Owner of any extensive problems.

16. Provide a written report for each inspection.

9.25 Ballistic Baffle System

A. Annually

1. Check condition of the plywood fronts, and replace broken panels.
2. Check for signs of wear or loosening at the hanging points and repair as required.
3. Check condition of the finish, and if surface is worn, repaint as needed.
4. Wipe down the surface and the top side of the baffles with an Escatech type solution to remove accumulation of lead particles from the muzzle smoke.

9.26 Target Holder and Retrieval System

A. Bi-Annually

1. Check for accumulated brass on top of the track and remove.
2. Check all fasteners on track and mounting brackets, and tighten as needed.
3. Check wear and tear on pulley, and replace as needed.
4. Check that target clamps are tight and secure.
5. Check lamps, and replace spare lamp as needed.
6. Clean the copper bus bar with a scotch brite pad.
7. Check aircraft cable tension and adjust for stretch by setting the coast factors.
8. Check for loose wiring connections, and tighten as needed.
9. Clean local screen and drive cover with a damp cloth and mild soap.

9.27 Acoustical Wall Treatment in Firing Range and Bullet Recovery Room

A. Annually

1. Check panels for surface damage. Repair dented or scratched panels or replace if required.
2. Check that panels are securely attached to support framing.
3. Check for water or moisture damage to absorbing material. Recommend replacement as needed.

4. Clean panels with cleaner recommended by manufacturer.

9.28 Small Sterilizer

A. Annually, unless otherwise noted

1. Inspect door assembly.
    a. Inspect condition of door gasket for wear and replace as necessary.
    b. Inspect door alignment with end ring.
    c. Lubricate hinge and hinge pins.
    d. Inspect for loose screws and tighten.
    e. Replace door lock diaphragm once a year.
    f. Grease door post and bearings once a year.
2. Inspect each hand valve for smooth operation and proper valve seating.
    a. Inspect valves for leaks.
3. Check cooling fan operation.
    a. Replace fan filter once a year.
    b. Confirm control calibration once a year.
    c. Replace battery backed ram chip as required.
    d. Verify operation of flood alarm control.
    e. Replace printer and ribbon cartridge as required.
4. Electric Steam Generator:
    a. Inspect all wiring and connections for damage and fraying.
    b. Test safety valves once a year.
    c. Inspect control wiring.
    d. Inspect fuses and fuse clips.
    e. Inspect heater controls.
    f. Inspect hand valves and replace as required.
    g. Inspect check valves and replace as required.
    h. Inspect solenoid valves for proper operation.
    i. Inspect pressure control switches.
    j. Verify proper setting of pressure switches.
    k. Verify pressure gauge, and check proper operation.
    l. Verify water level control operation.
    m. Clean heating element and boiler chamber.

n. Rebuild solenoid valves every six months.

o. Verify operation of safety valves every six months.

p. Clean strainers every six months.

q. Inspect water gauge glass and washers every six months and replace as required.

r. Clean water level control rods every 4 months.

s. Determine water hardness every 6 months.

t. Descale generator every 4 months.

5. Clean lint and dirt from components.

a. Inspect wiring, terminals, and socket connection for damage or fraying.

b. Run unit through each cycle to verify proper operation. Check all displays and printouts.

c. Remove all test equipment and replace all panels and covers removed during inspection.

9.29 Medium Sterilizer

A. Annually, unless otherwise noted

1. Inspect printouts for signs of trouble.

2. Inspect door assembly.

a. Inspect condition of door gasket for wear and replace as necessary.

b. Inspect door alignment with end ring.

c. Lubricate hinge and hinge pins.

d. Inspect for loose screws and tighten.

e. Replace door lock diaphragm once a year.

f. Grease door post and bearings once a year.

3. Hand Valve:

a. Inspect valve for smooth operation and proper valve seating.

b. Inspect valve for leaks.

c. Once a year, run manual cycle to test operation of multiport valve.

4. Inspect strainers for debris and clean as necessary.

a. Inspect steam trap for proper operation and replace as required.

b. Inspect each gauge for accuracy against test gauge. Replace gauge if required.

5. Other valves:
   a. Make internal inspection of each valve every six months.
   b. Run a leak test, and replace check valve if necessary every six months.
   c. Inspect each solenoid valve for proper operation and replace as required.
   d. Inspect steam control valve for proper operation.
   e. Flush out each flow control valve.
   f. Reset flow control valve to original marked setting.
6. Inspect each vacuum breaker for proper operation.
   a. Replace air filter cartridge every six months.
   b. Inspect chamber drain for debris.
   c. Every three months, check the float switch assembly mounted on the side of the jacket of the sterilizer. The float should move freely. If required, disassemble the unit and clean as necessary.
7. Electric Steam Generator:
   a. Inspect all wiring and connections for damage and fraying.
   b. Inspect water gauge glass and washers every six months and replace as required.
   c. Clean heating element and boiler chamber once a year.
   d. Clean water level control rods once a year.
   e. Descale steam chamber once a year.
   f. Check operation of pressure gauge.
   g. Verify proper setting of pressure switches.
8. Stage 3 Control:
   a. Calibrate temperature and pressure readout once a year.
      1. Replace battery backed ram chip as required.
      2. Verify operation of flood alarm control.
      3. Recommend replacement of printer as required.
   b. Clean lint and dirt from components.
      1. Inspect wiring, terminals, and socket connection for damage or fraying.
      2. Run unit through each cycle to verify proper operation. Check all displays and printouts.

3. Remove all test equipment and replace all panels and covers removed during inspection.

9.30 Glassware Washers/Dryers

A. Annually, unless otherwise noted

1. Door assembly:
2. Verify proper door and door switch operation. Adjust switch if needed.
   a. Inspect condition of door gasket for wear and replace as necessary.
   b. Every four months, lubricate door side gasket that contacts door guides, using silicone lubricant, to avoid screeching noise.
   c. Verify proper operation of door cables and pulleys. Check for wear and fraying and replace if needed.
   d. Every two years, replace cable.
   e. Check door glass for cracks. Replace door or glass if needed.
   f. On power door units, verify proper operation of door edge safety gaskets.
3. Valves: provide the following once a year, unless noted otherwise:
   a. Inspect check valves and replace as required.
      1. Replace pivot arm hose on drain valve as required.
      2. Rebuild drain valve every two years.
      3. Replace pivot arm hose on pure water outlet as required.
      4. Rebuild pure water outlet valve every two years.
      5. Replace pivot arm hose on transfer valve.
      6. Rebuild transfer valve every two years.
4. Piping Components: Provide the following on a bi-monthly basis unless noted otherwise:
   a. Inspect cold-water strainer and clean as needed.
      1. Inspect hot water strainer and clean as needed.
      2. Inspect steam strainer and clean as needed.
      3. Inspect sump trap once a year and replace as required.
      4. Inspect pure water tank trap once a year and replace as required.
      5. Check wash pump seals for leaks.
      6. Replace pump seals once a year.
5. Chamber Components:

a. Check rotary spray arm assemblies for free movement and even coverage. Clean nozzles if needed.

1. Every 4 months, check condition of nylon bushing that is installed between rotary spray arm hub and top of wash chamber.
2. Replace spray arm bushings once a year.
3. Clean bottom filters in wash chamber.
4. Check piping system for leaks. Recommend repair if needed.
5. Verify proper operation of water level controls.

6. Control:

a. Verify that printer and paper take-up operate properly.

1. Check printout for print quality.
2. Verify that touch pads function properly.
3. Verify that the date and time are correct, and set accordingly.
4. Verify operation of the battery-backed RAM. Replace as needed.
5. Verify that buzzer is working.
6. Once a year. Check all service-adjustable values in Service Mode for factory-recommended settings. Verify functional operation of each valve, using the Service Mode test.
7. Verify temperature displays/printouts potentiometer. Make adjustments as needed to:

b. Sump Resistive Temperature Devices (RTD) on a bi-monthly basis.

1. Dryer RTD quarterly
2. Pure water tank RTD on a bi-monthly basis.

7. Chemical Injection Pump:

a. Verify that rollers are not binding.

b. Annually, Verify that tubing is not clogged, cracked, crushed, or distorted. Clean/replace if needed.

c. Verify that correct amount of chemical is being dispensed, and adjust if needed.

d. Verify proper operation of low-level sensor.

8. Pneumatics:
   a. Verify proper operation of actuators.
      1. Check for leaks in the air lines. Repair if needed.
      2. Drain moisture form filter/regulator bowl. Check bowl for leaks. Replace bowl as needed. Replace filter element if clogged or rusty.
      3. Once a year, replace mufflers on air solenoid valves.
      4. Check cylinders for excessive wear and air leakage at seals. Recommend replacement of cylinders as needed.
      5. Verify pressure regulators are set and operating to specification.
9. Pure Water Tank: Verify proper operation of level control.
   a. Clean dirt from components. Check all wiring, terminals, and socket connections for damage or fraying.
   b. Verify that unit has proper safety warnings.
   c. Run machine through a cycle to verify proper operation. Check all displays and printouts.
   d. Remove all test equipment and replace all panels and covers removed during inspection.

9.31 Biological Safety Cabinets

A. The cabinets in this facility are Class II, Type A/B3, which must be certified by a qualified certifier whenever HEPA filters are changed, maintenance or repairs are made to internal components, or the cabinet is relocated. Additionally, decontamination of the cabinet with formaldehyde gas is required before maintenance work is performed in contaminated areas and prior to HEPA filter changes. Specific procedures for performing a gaseous decontamination of the cabinet is explained in detail in the NSF International/American National Standard for Biosafety Cabinetry (NSF/ANSI 49-2002).

B. The following schedule outlines the routine maintenance that is required to keep the cabinet operating efficiently. All of the recommended intervals listed are for cabinets that are operated on a regular basis, with no unusual ambient or procedural conditions. Optimum maintenance intervals may be greater or lesser depending on cabinet use. Provide the following in accordance with the manufacturer's maintenance instructions:

C. Annually
   1. Coordinate with CO to recertify the cabinet.
      a. Replace the UV and/or fluorescent lamp.

b. Perform all of the monthly maintenance operations listed above.

D. Monthly:

1. Check the blower pressure and record the pressure in the record log sheet.
2. Remove left and right end panels and check the service valves. Ensure that all service valves operate properly and that all supply lines have accessible cut off valves.

9.32 Laminar Flow Clean Benches

A. Monthly:

1. Check the polyurethane prefilter. Clean when necessary.
2. Check the velocity of air emanating from the workspace. If it falls below 90 FPM, the HEPA filter should be replaced.
3. Check for excessive vibration or noise and if necessary adjust the air balance between the filter and the air intake slots.
4. Check to make sure that the glass neoprene vibration isolator between the blower and the air plenum is intact.
5. Verify that the blower motor is balanced and securely fastened.
6. Check the lighting system and replace the lamps if necessary.
7. Coordinate with CO to arrange for yearly certification of the units by the authority having jurisdiction.

9.33 Fume Extractor Arms

A. Generally, the fume extractor arms are maintenance free. Twice each year, they should be inspected for loose, worn, or missing parts. Provide the following as necessary:

B. Bi-Annually

1. Check and tighten all fasteners and brackets.
2. Check connections to air ducts and secure as required.
3. Check that angle joints are operating smoothly and adjust as required.
4. Check for air loss at joints, and replace O-rings if necessary.
5. If hoods are provided with a light, replace burned out lamps as necessary.

9.34 Ductless Fume Enclosure

A. Filter replacement will depend on the frequency of use. The unit is equipped with an advanced monitoring system which provides built-in monitoring of both airflow and filter condition. Alarms will sound when the filters must be checked and replaced. Every six months, check the pre-filters, main filters, main carbon filters, and HEPA filters. Replace as required with the spare set of filters. Maintain one spare set of filters on site at all times.

B. Bi-Annually

1. Inspect the hood frame and panels for mechanical damage.
2. Inspect the hood door for corrosion.
3. Check the light bulb and replace if necessary.

9.35 Ventilated Work Station

A. Filter replacement will depend on the frequency of use. Every six months, the airflow should be checked with an anemometer in accordance with the manufacturer's recommended procedures. If the readings indicate reduced airflow at the sash opening, the filters may need to be replaced. Follow the manufacturer's recommendations in the operation and maintenance manual.

9.36 Laboratory Freestanding Fiberglass Sinks

A. Monthly

1. Check the sinks for loose fixtures, leaks, and stubborn stains. Tighten the fixtures as required, and remove the stains with a good grade automotive paste cleaner in accordance with the sink manufacturer's care instructions.

9.37 Laboratory Freestanding Stainless Steel Sinks

A. Monthly

1. Check for corrosion and chemical stains. If present, scour the surface with a mild abrasive cleaner in the direction of the grain of the stainless steel.
2. Check the sinks for loose fixtures, leaks, and rust stains. Tighten the fixtures as required and repair leaks.
3. If rust is present, contact the manufacturer of the sink for special cleaning instructions.

9.38 Gas Cylinder Restraints

A. Annually

1. Check woven straps for wear and tear. Replace as required.
2. Check hardware and replace damaged or broken fasteners.
3. Check chain for links that have become worn or spread apart. Repair as needed.

9.39 Roller Table

A. Annually

1. Check rollers for smooth operation. Lubricate as required.
2. Check all fasteners on table bed and legs and tighten as required.

9.40 Fume Hoods and Accessories

A. The exhaust system and blower of a fume hood must function properly for safety. Maintenance personnel should service the fan and motor assembly regularly, lubricate as required, and make sure that the exhaust system is free from obstructions. Accumulated deposits should be removed from the impeller blade and housing. Conduct a simple test with a lighted match or smoke to verify if the air is being drawn into the hood. Fume hood maintenance procedures consist primarily of cleanup, adjustment, lubrication, and replacement of worn, damaged or non-functioning parts. Lubrication of sash guides, cables, pulley wheels, and other working parts should be accomplished as required and replacement of broken, worn, or non-functioning parts as needed.

B. Bi-Annually

1. Liner and baffles for condition and cleanliness.
2. Low airflow detectors.
3. Service fixtures and lights.
4. Pulleys and belts.
5. Sash operation and counterbalance cables including a complete visual check of the entire system.
6. Make sure there is a 1/16-inch clearance between cable keepers and pulley sheaves.
7. Velocity and pressure sensing detectors.
8. Low or no flow alarms, both visible (lights) and audible (horns and bells).
9. Signal transmission for alarms designed to activate signals at more than one location.
10. Instrument verification of fume hood face velocity and determination of usage by observation and interview.
11. Ductwork and blower.

9.41 Wood Cabinets

A. Annually

1. Wood doors and drawer fronts: Repair scratches and gouges.

2. Within six months of initial completion, check all hardware, screws, bolts and nuts and tighten as required. Thereafter, examine all mechanical attaching devices on an annual basis.
3. Lubricate drawers and sliding doors. Apply a drop of fine oil to all hinges.
4. Check door and drawer hardware, tighten as necessary, and replace damaged units with matching hardware.

9.42 Plastic Laminate Countertops

A. Annually

1. Check for scratches, remove with light sanding, and buff entire top using an electric drill with cotton buffing wheel.
2. Repair punctured areas with a burn-in lacquer material or epoxy, in accordance with manufacturer's recommendations.
3. Repair loose laminate and seams with epoxy adhesive.

9.43 Solid Polymer Countertops

A. Annually

1. Product is virtually maintenance free. As required, scrub stubborn stains with abrasive cleaner.
2. Sand cuts and scratches with 180 or 220-grit fine sandpaper until cuts are gone. Restore finish with abrasive cleanser.
3. Check for severe discoloration or etching and repair same as above.
4. If surface has been damaged due to severe impact, contact manufacturer for repairs.

9.44 Metal Laboratory Casework

A. Annually

1. Metal doors and drawer fronts: Repair scratches and gouges.
2. Metal cabinets: Repair nicks and scratches.
3. Within six months of initial completion, check all hardware, screws, bolts and nuts and tighten as required. Thereafter, examine all mechanical attaching devices on an annual basis.
4. Lubricate drawers and sliding doors. Apply a drop of fine oil to all hinges.
5. Lubricate steel drawer suspension roller bearings on both drawer and cabinet runs. Clean dirt and debris from roller surfaces and raceways.
6. Check locks for ease of operation. Do not use oil. Use lubricants such as graphite or silicon spray.
7. Check resilient base and re-cement as necessary.

8. Check casework for broken glass and replace as necessary.
9. Check door and drawer hardware, tighten as necessary, and replace damaged units with matching hardware.

9.45 Epoxy Countertops and Sinks

A. Bi-Annually

1. Repair cracks or voids in seams as necessary.
2. Inspect counter tops. Insure that joints are sealed and solid.
3. Repair scratches and minor chips as recommended by the manufacturer of the counter tops.

B. Monthly:

1. Inspect to insure the seal between the sink and counter top, and the seal between tub and sink plug is still good.

9.46 Stainless Steel Countertops and Sinks

A. Annually

1. Inspect to insure the seal between the sink and counter top, and the seal between tub and sink plug is still good.

9.47 Adjustable Height Laboratory Tables

A. Annually

1. Check all fasteners and tighten as required.
2. Recommend replacement of worn or broken parts.

9.48 Laboratory Pegboards

A. Annually

1. Check polypropylene pegs and replace broken pegs as required.
2. Recommend replacement of damaged drain accessories if necessary.

9.49 Paper Dispensers/Cutters

A. Annually

1. Verify that cutter is in good working condition.
2. Check cutting blade and sharpen as required.
3. Verify that roller turns smoothly.
4. Recommend replacement or repair of worn or damaged parts.

9.50 Mechanical Service Fixtures

A. After the second year of operation and every two years thereafter:

1. Check parts for wear and repair as necessary.

B. Annually

1. Check for damage to chrome plated finishes, and repair as necessary.
2. Check ground key gas cocks for ease of operation. Loose or hard working cocks can be improved by adjustment of the compression spring. After two years, disassemble and lubricate with vacuum wax.
3. Check for loose handles and tighten as necessary.
4. Check for leaks and tighten bonnet nut if necessary. Should corrosion, wear or damage occur at needle point or seat, recommend replacement of complete assembly.
5. Check water fixtures for leaks and replace washers as necessary.
6. Check water flow, and if required, take unit apart and flush to remove dirt and particles.

9.51 Eye Washes and Safety Showers

A. Quarterly

1. Quarterly, test the volume deluge on the emergency showers and complete the inspection record next to each unit.

B. Weekly

1. Every week, test the eye washes and complete the inspection record next to each unit.

9.52 Instrument Carts

A. Annually

1. Lubricate casters.
2. Check and tighten all fasteners as required.

9.53 Motorized Vertical Blinds and Roller Shades

A. Annually

1. Clean the vanes with a damp cloth and mild soap, and as recommended by the manufacturer.
2. Check that motors and controls operate as intended by running the units through several cycles. If problems are found, contact the manufacturer for repairs and service.
3. Check units for worn or unraveled cords.
4. Lubricate chains as recommended by the manufacturer.
5. Check rollers for proper operation and condition of shade material.
6. Check shade material for tears. Contact manufacturer for repairs.
7. If units malfunction in any way, contact the manufacturer for repairs.

9.54 Cold Storage Rooms

A. Annually

1. Heaters: check electrical connections for tightness and conductors for wear.
    a. Sensors: Inspect for signs of damage.
    b. Inspect for signs of damage.
2. Check unit filters, if installed.
    a. Verify blowers are operating, reactivation heat is operational, and room conditions are as specified.
    b. Execute additional procedures as may be indicated in dehumidifier manufacturer's operating and maintenance manual.
3. Humidifier:
    a. Check unit for accumulation of sediment, scale, or other contaminants from feedwater.
        1. Clean or replace water tank as needed.
        2. Check vapor hose or piping for leaks, worn areas, or missing insulation. Repair as needed.
        3. Measure heater current under full load and compare to unit baseline data. Replace heaters if current is insufficient.
        4. Execute additional procedures as may be indicated in humidifier manufacturer's operating and maintenance manual.
        5. Controls: Tighten electrical connections after 90-days and then yearly.

B. Bi-Annually

1. Refrigeration System
    a. Check condensing unit for leaking oil.
        1. Check condenser fan operation.
        2. Check oil level in crankcase.
        3. Check liquid line sight glass for moisture indication and low refrigerant.
        4. Tighten fasteners.
        5. Check suction and discharge pressures
2. Condensate Drain
    a. Check drain pan and clean as needed.

1. Verify that flow to drain connection is unrestricted.

3. Evaporator:

a. Execute defrost cycle on cold room/freezers.

1. Verify termination is by coil temperature.
2. Adjust parameters as needed.
3. Check coil for excessive front or ice buildup.
4. Verify smooth fan operation.
5. Tighten cabinet fasteners.

C. Quarterly:

1. A qualified mechanic or technician should perform the following in accordance with the manufacturer's instructions. The items listed can usually be checked without having to shut down the controlled environment room.

2. Inspect Door

a. Check gasket for wear or misalignment and replace as needed.
b. Lubricate hinge pin with petroleum jelly.
c. Check for condensation on door jamb.
d. Tighten bolts on hinge and handle.
e. Check gasket for wear or misalignment and replace as needed.
f. Lubricate hinge pin with petroleum jelly.
g. Check for condensation on door jamb.
h. Tighten bolts on hinge and handle.

D. Monthly:

1. Check for missing plug buttons in panels and replace as needed.
2. Door: Check for smooth operation of hinges, closure mechanism, emergency release handle and lock.
3. Recorder: Change chart, check pen trace line, and replace pen as needed.
4. Condensing Unit: Remove debris, dust, leaves, grass or other materials that may block airflow to air-cooled units.
5. Circulation Fans: Listen for abnormal noise indicating excessive bearing wear or misalignment. Verify rotation.
6. Evaporator: Check for excessive ice build up or debris blocking airflow.
7. Lighting: Check for inoperative lamps and replace as needed. Clean lens when lamps are replaced.

8. Alarm System: Check function by creating alarm condition with modified set point.

9.55 Dock Lift / Bumpers

A. Bi-Annually

1. Change hydraulic fluid for ambient temperature changes if appropriate.
2. Check the fluid reservoir to see if there is any evidence of accumulated condensation creating water contamination.
3. Inspect bumpers for damage, loose anchoring and alignment problems. Repair or replace as required.

B. Monthly:

1. Check that the hydraulic fluid level in the reservoir is 1/2-inch (25 mm) from the top of the tank with the unit fully lowered.
2. Clean all debris from the pit in order to avoid interference with the lift mechanism or rollers.
3. Check for presence and proper seating of all snap rings and clips on all axles, cylinders, and rollers.
4. Check rollers, pins, and bushings for signs of wear such as flat spots, missing fasteners, or dislodged bearing material.
5. Check the hydraulic fittings for cracks or leaks and clean up seepage on or beneath the cylinders.
6. Check hoses and electrical lines for abrasions or other abuse and check for snug connections.
7. Operate the unit and check for any abnormal noise or vibrations.
8. Check safety devices on the unit such as handrails, safety chains, toe guards, and chocks for proper operation.
9. Check the hinged bridge to insure that its stops are not damaged, allowing it to droop more than 45 degrees below horizontal. Check the hinge spools for cracks and or broken welds. Be sure the bridge leans back over the platform at least 20 degrees beyond vertical.

C. Weekly:

1. Routine maintenance is minor and consists of periodic checks.
2. The lab should raise the lift to its full height once a week to get rid of cylinder seepage buildup and to lubricate the upper cylinder barrel.

9.56 Vehicle Lift

A. To avoid personal injury, and or property damage, permit only trained personnel to operate the lift. Observe and heed safety and warning labels on the lift. Permit only qualified lift service personnel to perform maintenance on this equipment.

B. Bi-Annually

1. Check fluid level of lift power unit and refill if required. If fluid is required, inspect all fittings, hoses, and seals. Repair as required.
2. Verify that required safety instructions, signs, and printed operational instructions are posted and in good condition. Recommend replacement of damaged and worn out signage as necessary.
3. Replace all caution, warning or safety related decals on the lift if unable to read or missing.
4. Replace important decal on outside of yokes if unable to read or missing.

C. Monthly:

1. Replace damaged or worn parts.
2. Review the daily maintenance records.
3. Verify that safety devices are in good working condition.
4. Lubricate lift guide barrels using synthetic grease.

D. Weekly:

1. Check all attaching bolts for tightness.
2. Always raise lift when cleaning floor area with solvents and/or cleaning compounds.
3. Always keep superstructure clean.
4. Always make sure the perimeters of the guide barrel and center cover are sealed with a good grade of silicone.
5. Be sure plugs on superstructure are in place.
6. Inspect adapters for damage or excessive wear. Recommend replacement if necessary.
7. Check locking latch operation.

9.57 Overhead Crane

A. Annually

1. After first year of operation, check the lubrication of the toothed travel wheel of the carriage. Thereafter, provide this service every two years.
2. Carefully examine load hooks for cracks and cold deformation in accordance with the accident prevention regulations.

3. Carefully examine crane and trolley carriages, in particular the condition of the flanges and antifriction bearing seals and traveling hoist approach dimensions.
4. Check and apply or supplement corrosion protection as required.
5. Check adhesive grease in bearings of return sheaves, crossheads, compensating sheaves, and pins of anchorage and re-grease as required.

B. Bi-Annually

1. Check the wire ropes for wear, broken wires, and damage. Replace as recommended by the manufacturer.

C. Quarterly

1. After first three months of operation, check path of rotor displacement and adjust as necessary. Thereafter, provide this service once a year.
2. Oil rope, grease rope drum and rope guide. Check bottom block and hook fittings. Thereafter, provide this service once a year.
3. Check all bolted connections, nuts, and welds. Thereafter, provide this service once a year.
4. Check current supply lines. On busbar lines, check insulators, busbars, connections, and expansion joints. On current collectors, check sliding contacts and travel wheels for wear and sliding contacts for contact pressure. Thereafter, provide this service once a year.
5. Check electrical switchgear and wiring. Check limit switch for corrosion. Thereafter, provide this service every 6 months.

Management Plan & Systems Operation Maintenance Manual Templates

INDEX OF VOLUMES

INTRODUCTION

The Design, Construct, Commission Pilot Program consists of a two phased program during which the Contractor of Record provides continuous service. This pilot program streamlines the transition from construction into the operating phase of the building. Continuity will be provided by including the design team, construction contractor and the owner/user in the critical initial phases of occupancy, through the warranty periods of systems and equipment and into the first five years of occupancy. Further enhancement is achieved by insuring continuity of knowledge and professionalism remains consistent during the first five years of operation at the facility. Preventive and Corrective/Unscheduled Maintenance will be provided under this program. Minor repairs will be accomplished as part an organized approach. The building systems will be monitored and benchmarked throughout the life cycles of the system. Emergency responses will be provided using a priority matrix.

Phase 1 of the pilot project spans the routine construction services through the Beneficial Occupancy Date of the laboratory. Phase 2 spans the first five years of use, concerning the operation and maintenance of the laboratory. The intention of the pilot program is to design, construct, and maintain the facility such that all building systems and equipment perform within the performance guidelines throughout the life cycle of the facility.

This comprehensive approach will create seamless O&M support service from design, construction, move-in and through the first five years of occupancy. The following documents guide the execution of the operation and maintenance mission:

- Construction Documents – Drawings and Specifications
- VOLUME 7 – Operation and Maintenance Statement of Work
- Appendix A – Management Plan and Systems Operation and Maintenance Management Templates
- Equipment Manufacturers' Instructions

The Construction Documents, comprised of Drawings and Specifications, serve as means for constructing the facility and bringing the systems and equipment into an integrated whole allowing the facility to function as designed. These documents serve as the basis for establishing performance criteria for each building system.

VOLUME 7, Operation and Maintenance Statement of Work defines the requirements of the contractor during the operation and maintenance phase of the contract.

Appendix A Volume 1, Comprehensive Management Plan and Volumes 2-9, Systems Operation and Maintenance Manual Templates are intended to serve as outlines for the requirements to be completed by the Contractor.

Equipment Manufacturers' Instructions are specification and support documents provided by the manufacturers of the equipment and systems installed in the USACIDL.

Using the templates provided in Appendix A as a guide, the Contractor shall derive three major deliverables to support the O&M phase of the contract:

- A comprehensive management plan that aggregates and integrates all supporting actions required to deliver an effective preventive maintenance management program.

- A comprehensive series of operation and maintenance manuals, updated annually, for each of the building systems that serve as guidance documents for the various journeyman-level tradespersons; and
- The execution of an effective maintenance program that meets the objective of the OMEE program.

Several sections of each volume have been initialized by the design team:

a. General Information
b. Specific Systems Descriptions
c. Theory of Operation
d. Design Master Equipment List
e. Training Requirements (minimum)
f. Exhibits

VOLUME 1

VOLUME 7 OPERATION AND MAINTENANCE REQUIREMENTS

Management Plan & Systems Operation Maintenance Manual Templates Appendix A

Comprehensive Management Plan

Table of Contents

1.1 Comprehensive Management Plan Guidance

A. General Requirements

1. Using the Management Plan and System Operation and Maintenance Manual Templates as a guide, the Contractor shall prepare the final Systems Operation and Maintenance Manual (SOMM). See Exhibit SOW-1 for the format of the SOMM.
2. The SOMM shall be organized by building systems as defined in Chapters 2-9 in the O&M SOW.
3. The Contractor will organize each volume's contents using the O&M Statement of Work for guidance. The Contractor shall revise all volumes, sections, chapters, etc. to provide a comprehensive and up-to-date manual incorporating actual as-built conditions and current manufacturer's data.
4. Each volume is designed to 'stand alone' – providing sufficient guidance and supporting material to allow a properly trained, journeyman technician to perform proper services.
5. Preparation of the SOMM shall be under the direction of an individual or organization that has demonstrated expertise and a minimum of 10 years experience in the preparation of comprehensive and complete O&M instructions for similarly complex systems. Qualifications shall be submitted for Contracting Officer approval.
6. Comprehensive Facilities Management Plan & SOMM preparation shall be identified as activities in the construction sequence of the Progress Schedule for the construction phase of this contract.
7. Final copies of the SOMM are due to the CO no later than 60 days prior to the start of the O&M phase of the contract.
    a. Contractor shall furnish one (1) copy of the Comprehensive Facilities Management Plan & SOMM on electronic media in Microsoft Word™ format, and six (6) hard copies.
8. On the annual anniversary of the start of the O&M phase of the contract, the Contractor shall update the manuals. The Contractor shall furnish one (1) copy of the updated Comprehensive Facilities Management Plan & SOMM on electronic media in Microsoft Word™ format, and six (6) hard copies.

B. General Information

1. The Comprehensive Management Plan Volume aggregates and integrates all the management subsystems that comprise the comprehensive plan for adequately operating and maintaining this facility. Information and procedures shall be documented in this manual, and be used throughout the contract term for reference and storage of information.

2. The Comprehensive Management Plan volume shall contain at a minimum, the following operational/management systems plans:
   a. Organization and Staffing Plan
   b. Security Plan
   c. Safety Program Plan
   d. Training Plan
   e. Warranty Plan
   f. Contract Maintenance Plan
   g. Continuous Commissioning Plan
   h. Preventive Maintenance Plan
   i. Quality Control Plan
3. Each plan will include all the information to meet the requirements stated in the pertinent contract documents and as outlined in the Operations and Maintenance Statement of Work.
4. The Contractor, in concert with the COR and the Director of the Lab will use tools outlined in the comprehensive management plan to develop the benchmarks against which building systems performance will be measured.
5. Specific systems information will be developed through the submittal and shop drawing and purchasing process, and focused on the manufacturer's specific requirements for Operation and Maintenance.
6. All information of this manual shall be computerized and be maintained in the FMS database system.
7. The maintenance manuals shall be kept updated and located on site in the Contractor's designated area.
8. The volumes may have several binders or subparts as required to keep all the documented information.

1.2 Exhibit MS-1 Master Equipment List Template

Design Master Equipment List						
SPECIFICATION REFERENCE	DESIGN DRAWING NUMBER	LOCATION	TAG NUMBER	NOMENCLATURE	CHARACTERISTICS	ITEM MANUFACTURER

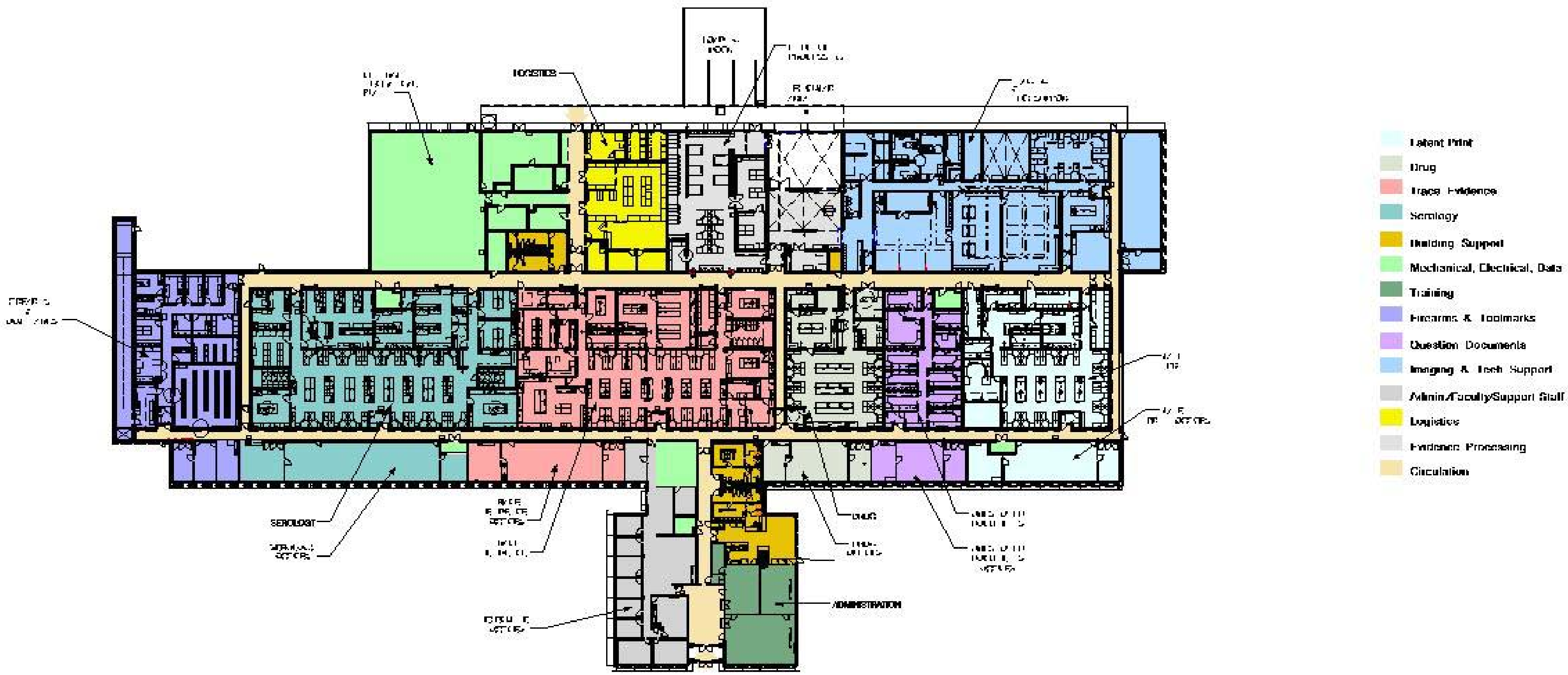
1.3 Exhibit MS-2 Training Schedule Template

SYSTEM:							
TRAINING TIME BY EQUIPMENT & EQUIPMENT SYSTEMS				Number of Hours		Schedule	
Specification Section	Equipment or Systems	Tag Number	O/M Staff Training	Classroom	Site	Planned	Actual

1.4 Exhibit MS-3 Warranty Information Template

SYSTEM:						
Warranty Information						
Specification Section	Equipment or Systems	Manufacturer	**Warranty Term**	**Warranty Call**	**Scheduled Inspection**	**Actual Inspection**

1.5 Exhibit MS-4 Reference Drawings



VOLUME
2

VOLUME 7 OPERATION AND MAINTENANCE REQUIREMENTS

Management Plan & Systems Operation and Maintenance Manual Templates Appendix A

Site Systems

Table of Contents

2.1 General Information

A. The Management Plan & Systems Operation Maintenance Manual Templates are a part of the comprehensive program for operation and maintenance of the US Army Criminal Investigation Laboratory. For detailed information of how this section fits into the overall documentation of a comprehensive operation and maintenance program, reference the following related documents.

1. VOLUME 7 - Operation and Maintenance Statement of Work
2. Appendix A – Management Plan & Systems Operation and Maintenance Manual Templates
3. Drawings and Specifications
4. Equipment Manufacturer's Instructions

B. This volume is not intended to replace contract documents, shop drawings, as-built drawings, or equipment manufacturers' instructions. The intent is to supplement such documents and provide an overall format for organizing the information necessary to operate and maintain the system.

C. For guidance in completing this volume, reference O&M SOW Chapter 1 – 'Statement of Work' and Appendix A Volume 1 – 'Comprehensive Management Plan'.

D. The importance of the site systems cannot be overstated because they set the environmental tone for the lab and are an integral part of the employee and visitor experience.

E. The site systems are static or underground and often go unnoticed in the background. For this reason, the site systems must be regularly inspected, tested, and maintained to ensure they are fully functional at all times.

F. This volume has been prepared for the maintenance personnel who will be responsible for the daily operation and maintenance of the electrical systems installed in the USACIL. The purpose of this volume is to familiarize maintenance personnel with the operation and maintenance of the electrical system at the USACIL, and to provide emergency and troubleshooting procedures.

2.2 Specific System Descriptions

A. Erosion Control System

1. The erosion control systems consist of protection of existing and new pavement and storm drainage inlets during rough grading operations and final grading. Protection may consist of seeding disturbed areas, providing silt fencing and temporary sediment traps.
   a. Temporary sediment traps will be used to contain and control sediment during the rough grading operation.
   b. Two temporary gravel construction entrances will help control sediment on vehicular traffic on and off the site during construction.

c. Silt fences will be installed around all drainage yard inlets.

d. Silt fences and small stones will be installed around the opening of drainage curb inlets.

e. Silt fences will also be installed around the perimeter of the site.

f. Temporary grassing will be used to stabilize disturbed surface areas during construction.

B. Storm Drainage System

1. The purpose of the storm drainage system is to control surface water runoff from rain events. The drainage system includes such features as: drainage swells, concrete curb and gutter, yard inlets, curb inlets, building gutters, roof drainage piping and storm drainage piping. Proper control of rainwater on building roofs, parking lots, roads, and service yards allows for safe travel of pedestrians and vehicles during rain events.

a. Runoff from building roof areas have two different collection systems. The first system consists of gutters and downspouts that are collected by underground laterals that discharge into drainage inlets and manholes of the underground storm drainage system. The second system consists of internal roof drains that are conveyed through laterals, which connect to the underground storm drainage system.

b. Surface water runoff from parking lots, utility yards and streets is collected through curbs, gutters, and catch basins. It is then discharged into the site's underground storm drainage piping system.

c. The site's underground storm drainage piping system consists of a 300mm to 600mm diameter pipe which conveys surface and building roof drainage to out-fall piping systems on the northwest corner of the site and west of the site.

C. Sanitary Sewer System

1. The sanitary sewer system collects and directs wastewater from the facility to the site's sanitary sewer out-fall system. Wastewater from this facility includes lab waste, floor drains, cooling tower blow down and domestic waste. The wastewater is collected within the facility and discharged to the site's sanitary collection system on the east side of the facility. The existing sanitary collection system flows to the abandoned wastewater treatment plant, which is located in the northeast corner of the post. From this point, the sewage is metered and sent into the Clayton County Sewage System and conveyed to the Dekalb County Sewage System for treatment and disposal.

a. All of the sewage is collected within the building through a series of piping systems and is discharged in to a sanitary sewer manhole on the east side of the building in two locations.

b. The lab waste is also collected within the building through a series of piping systems and is discharged into a lab waste monitoring structure on the east side of the building in two locations. The lab waste from the monitoring structure is discharged into the same sanitary sewer manholes as the building sewage.

c. Both lateral discharge pipes for the lab waste and sanitary sewage are 150mm in diameter.

d. The site's collection system consists of sanitary sewer manholes and 200mm piping. The sewage flows into the existing sanitary collection and discharges into the post pumping station.

D. Exterior Water System

1. The post had two separate water distribution systems. One is for domestic water and the other is for fire protection. The exterior domestic water system is supplies by water from the City of Atlanta and Clayton County. The facility is looped by a 150mm diameter piping system. The exterior fire protection system is supplied by an elevated water tank located the north of the facility site. The facility site is looped by a 250mm diameter piping system.

2. Domestic Water Distribution System

a. <u>Supply</u>: The existing water is supplied to the post from the Clayton County Water Department and the city of Atlanta. A 200mm line along Moreland Avenue enters at the east gate. The pressure is reported to be 538kPa. A 250mm line enters at the west gate at Jonesboro Road. The pressure is reported to be 586kPa. Each line is metered at the point of entry into the post distribution system.

b. <u>Post Distribution System</u>: Distribution remains throughout the post ranges in size from 150mm to 250mm and consists of cast iron and PVC pipes. Extensive replacement, modification and upgrade of the distribution lines have been done in recent years.

c. <u>Site Distribution</u>: The existing site for this facility is surrounded on all four sides by a domestic water line that is approximately five to six years old.

d. Facility domestic water system will be supplied on the west side of the building and tie into the existing 150mm water line located on the west side of North 34th Street.

3. Fire Distribution System

a. <u>Supply</u>: The existing fire distribution system is supplied from a 250,000 gallon elevated storage tank located to the north of the new facility.

b. <u>Site Distribution</u>: The existing fire distribution system for this facility surrounds the site on all four sides. The system's pipes are over forty years old and in bad condition. The post is in the process of upgrading this system to surround the facility with 250mm schedule 80 PVC pipe.

c. Facility fire distribution water line will be located on the west side of the facility and tie into the new installed 250mm fire line (by the post) located on the east side of North 34th Street.

d. The fire department pumper connection has been located between the utility yard and 34th Street.

4. Fire Hydrants

a. 150mm lines stub out from the fire water loop to serve fire hydrants around the perimeter of the facility and parking lots.

b. Hydrants are located near parking lots for a maximum hose pull not to exceed 50 meters.

c. Hydrants are located around the perimeter of the site to insure any area of the building can be served by a maximum hose pull not to exceed 105 meters.

d. A single fire hydrant is located within 10 meters of the fire department connection on the west side of the facility.

5. Valves

a. A post indicator valve (PIV) has been located on the 200mm diameter feeder pipe to the building sprinkler system. The PIV is manually operated with a wrench. The PIV will be locked shut with a tamper switch supervised back to the fire alarm panel.

b. Isolation valves are located on the fire and domestic water loops.

c. 150mm gate valves and boxes are located on all fire hydrant lateral piping.

2.3 Theory of Operation

A. Erosion Control System

1. The purpose of the sediment and erosion control systems is to prevent erosion of soil and retain any sediment that occurs on the construction site.

2. The purpose of the temporary construction entrance is to reduce erosion caused by vehicles during wet weather, and to prevent having to re-grade permanent roadbeds between initial grading and final grading. Stabilization can be established by using stone on top of a filter fabric.

3. The purpose of the straw bale barrier is to intercept and detain sediment and decrease flow velocities from small drainage areas. Bales are applicable where sheet and rill erosion may be a problem. Maximum effective life is three months.

4. The purpose of the silt fence is to intercept flow velocities from small drainage areas. The silt fence barrier is constructed on posts, filter fabric, and in some cases, a wire support fence. Silt fence barriers are normally

placed across or at the toe of slop or in a minor drainage way. Maximum effective life is six months.

5. The purpose of the storm drain inlet protection is to trap sediment before it enters the drainage inlet. Storm drain inlet may consist of stone and filter fabric, or filter fabric and straw bale barriers. Maximum limit of drainage area is one acre and is not intended to control large concentrated storm water flow.
6. The purpose of the temporary sediment trap is to detain sediment-laden runoff during rough grading from small-disturbed areas for enough time to allow most of the suspended solids to settle out. Maximum effective life is eighteen months.
7. The purpose of temporary seeding is to establish temporary vegetative cover on disturbed areas that will not be brought to final grade for periods of thirty days to one year.
8. The purpose of dust control is to reduce surface and air movement of dust during land disturbance, demolition or construction activities in areas subject to dust problems in order to prevent soil loss and reduce the presence of potentially harmful airborne substance.

B. Storm Drainage System

1. The purpose of the storm drainage system is to control and convert rainwater during storm events.
2. Open surface areas are graded and grassed to convey surface runoff to the drainage wells that direct the water to the storm drainage system.
3. Paved areas are graded to convey surface water to curbs and gutters that direct the water to drainage inlets and catch basins.
4. Building roof rainwater is controlled and conveyed through gutters and downspouts and roof drainage pipes. Both methods direct rainwater to the storm drainage piping system.
5. The storm drainage piping system consists of drop inlets, curb inlets, catch basins and headwalls. The storm drainage piping systems consist of pipes ranging in size from 300mm to 600mm. The pipe system operates under gravity flow and conveys the surface runoff to the drainage open channels. The piping system is designed to provide full capacity for the ten year/twenty-four hour rainfall event.

C. Sanitary Sewer System

1. The purpose of the sanitary sewer system is to convey wastewater to the treatment plant to be treated before released back into the environment.
2. The building wastewater and lab waste is collected with a series of pipes that convey the wastewater to the site's sanitary sewer distribution system by gravity flow.

3. The collection system consists of a series of pipes and manholes that conveys the wastewater by gravity flow from the site to a post sanitary sewer lift station.

4. Wastewater from the post sanitary sewer lift station is collected in a wet well of the lift station. The pumps in the lift station pump the wastewater through force main piping to the Clayton County sewer collection system that conveys the wastewater to the Dekalb County sewage system for treatment and disposal.

D. DomesticWater System

1. The purpose of the domestic water system is to provide safe drinking water for personnel working within the facility. Laboratory and cooling water is also provided by this system.

   a. Domestic water is provided to the post from the Clayton County water department and the city of Atlanta water system. The water is delivered to the post through a series of underground pipes. Either main has more than adequate capacity to supply the peak demand for this facility.

   b. The domestic water distribution system loops the facility. The loop is supplied by water mains from the post. One 150mm diameter pipe provides water to the facility on the west side off of the exterior water loop. Valves are located on the loop system to allow isolation of sections of the loop and individual feed to the facility for maintenance and repairs.

   c. Pressure for the water system on the exterior of the site is provided by Clayton County and the City of Atlanta water system. The pressure is reported to be 538kPa at the post east gate and 586kPa at the west gate.

2. Fire Water System

   a. The purpose of the fire water system is to provide adequate flow and pressure in the event of a fire.

   b. The fire water supply is provided from a 250,000 gallon elevated water storage tank located adjacent to the facility on the north side. The water storage is more than adequate for fire protection for this facility.

   c. The post has installed a new fire loop around the facility. The loop is fed from the elevated water storage tank. The building's fire system is fed on the west side of the building by a 200mm underground fire line off of the facility fire loop. Valves are located on the loop system to allow isolation of sections of the loop and individual feed to the facility for maintenance and repairs.

   d. Fire hydrants are installed along the facility fire loop to provide fire flow to fight fire at the facility.

e. A post indicator valve (PIV) has been installed on the feeder fire line to the building sprinkler system. This post indicator valve is locked in the open position to insure firewater flow to the building sprinkler system in case of a fire. There is also a tamper switch located on the PIV, wired back to the fire alarm panel. This switch will indicate at the alarm panel if anyone has altered the PIV.

2.4 Operations

A. The contractor shall provide and incorporate the following information into this Section for each system identified in this Volume.

1. Operations: The operating instructions shall include equipment and/or system layouts showing all piping, wiring, breakers, valves, dampers, controls, etc., complete with functional diagrams, schematics, isometrics, and data to explain the detailed operation and control of each individual piece of equipment and/or system, including system components. Layouts shall show the location within the facility of controls, valves, switches, dampers, etc., by reference to site location, wing designation, floor, room number, or other clear and concise directions for locating the item. Operator data may be identical to posted data and framed instructions, but shall be prepared as part of the O&M manuals. The instructions shall include:

a. Initial adjustments and control settings

b. Precautions and prechecks to be executed prior to startup of equipment and/or system, including safety devices, monitoring devices and control sequence.

c. Step-by-step sequential procedures for startup and normal operation checks for satisfactory operation. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the operating instructions and flagged for the attention of the operator. Procedures shall include test, normal, and automatic modes.

d. Procedures for normal and emergency shutdown of equipment and/or systems. The instructions shall include any procedures necessary for placing the equipment and/or system on standby or preparing the equipment and/or system for startup at a later time. Procedures shall include test, normal, and automatic modes.

e. Procedures for isolating individual equipment from the system and bringing individual equipment on line once the system is operating.

f. Operational logs and records requirements.

2.5 Preventive Maintenance

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Preventive Maintenance: Recommended procedures shall indicate PM (e.g., lubrication, checks, adjustments, etc.) and good-housekeeping practices which should be performed by operating personnel, as well as more complex maintenance procedures which would normally be performed only by trained maintenance personnel. The procedures shall be accompanied by a schedule indicating timeframes or operating hours for specific maintenance to be accomplished. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the maintenance procedures and flagged for the attention of personnel. The procedures shall include necessary operating instructions for taking equipment off-line, on-line, and putting equipment on standby. The instructions shall address all material, equipment, and system data needed to perform maintenance work and shall include, but not be limited to, manufacturers' bulletins, catalogs, and descriptive data; copies of approved test plans, including logs and records of performance acceptance test results and actual adjustments made during final acceptance and inspection; system layouts, including block, wiring, control, and isometric diagrams; schematic items within the facility; and interrelationships with other items of the system.

2. Schedules indicating timeframes or operating hours for initiating operator maintenance and adjustments and including manufacturer's recommended major maintenance requirements shall be provided. Emergency adjustments shall be included and flagged for the operator's attention. The instructions shall also include procedures for emergency repairs that could be performed by operating personnel.

2.6 Trouble Analysis

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Trouble Analysis procedures for locating and correcting the trouble shall be presented in a step-by-step format. Repair procedures shall be keyed to a troubleshooting guide outlined in three columns with the following headings:

Trouble/Symptom	Probable Cause(s)	Corrective Action
The indication or symptom of trouble	The instructions, including test hookups, necessary to determine the cause(s)	Procedures for restoring the system to operating condition, or cross reference to where the procedure is written in SOMM

2. The procedures shall clearly indicate a major repair activity, which should be performed only in a shop or factory, as opposed to normal repair work, which may be performed on-site or with equipment online. The procedures shall also clearly indicate the limit of repair work that may be performed by maintenance personnel during the warranty period without voiding warranty provisions. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the repair procedures and flagged for the attention of personnel.

2.7 Corrective/Unscheduled Maintenance

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Corrective/Unscheduled Maintenance and Checkout Procedures: Procedures for troubleshooting and isolation, replacement, checkout, and integration of equipment within the system shall be provided.
2. Trouble Analysis: Procedures for troubleshooting of malfunctions that might occur during operation of the system shall be provided. Troubleshooting data, and fault isolation techniques, shall state the following:
    a. The indication or symptom of trouble;
    b. The instructions, including test hookups, necessary to determine the cause; and
    c. Procedures for restoring the system to operating condition.
3. Troubleshooting shall be documented to the extent necessary to locate the faulty piece of equipment within the system. Information may be in chart form, in logic tree form, or in tabular format with appropriate headings.
4. Isolation, Replacement, Checkout, and Integration: Procedures for isolation, replacement, checkout, and integration of the equipment within the system shall be provided. Test, adjustment, and checkout data, after replacement, shall be included.

2.8 Repair Parts and Special Tools and Equipment

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Repair Parts List: A complete list of repair parts and supplies shall be provided. The list shall include all parts and components of individual pieces of equipment and all parts and components of each system and shall identify such items as nomenclature of part, model number, circuit of component identification, etc. Parts and supplies lists shall be included within each volume of maintenance instructions. Further, a master list of repair parts and supplies recommended from each manufacturer for one year of operation, including source of supply, shall be sub-listed with each instruction. The Contractor shall also list the sources of supply for all parts and supplies, including name of supplier/manufacturer, address, and telephone number. If the parts and supplies are not normally stocked locally, necessary procurement lead-time shall also be a part of the listing.
2. Special Tools and Test Equipment List: A list of all special tools and test, measurement, and diagnostic equipment required for system level maintenance shall be included. For the purposes of this specification, the phrase "special tools and test, measurement, and diagnostic equipment" is used to identify all nonstandard tools and equipment designed and developed by the manufacturer and others to perform maintenance, test/calibration, diagnostic/prognostic analysis, and other related support of the equipment, as well as nonstandard tools required for installation, acceptance testing, and successful O&M. Frequency and method of calibration shall be indicated for all special tools, equipment and test equipment items that require calibration. Necessary standards shall be listed immediately after each item that requires calibration.

2.9 Vendor Data/Acceptance Tests

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Vendor Data: A complete set of data, provided by the equipment manufacturer, required for operation, maintenance and checkout shall be included and referenced to the appropriate specification number. Their data may consist of manufacturers' brochures, O&M manuals, catalogs, drawings, service bulletins, and illustrated parts lists necessary to support the O&M of the end item of equipment and assemblies.
2. A record of all Systems' Acceptance Tests shall be included in this section.

2.10 Warranty Information

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Warranty Information: In addition to the general warranty required and provided under the contract, the O&M manuals shall include any specific warranties required by other sections of the Technical Specifications and other warranties normally provided with the particular piece of equipment or system. Warranties that are normally provided by manufacturers and which are beyond the warranty for construction shall be specifically noted.

2.11 Design Master Equipment List

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. A completed master equipment list with guidance offered in Volume 1 - Comprehensive Management Plan. Exhibit MS-1 See information on the preparation of the Management Plan & Systems Operation and Maintenance Manual for further instructions on the preparation of this list.
2. Reference Exhibit ST-1. All manufacturer's data on the operation and maintenance of the equipment.

2.12 Training Requirements

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. A training schedule in accordance with guidance offered in Volume 1 - Comprehensive Management Plan.
2. Reference Exhibit ST-2 for guidance in the preparation of this schedule.

2.13 Exhibits

1. ST-1 Design Master Equipment List
2. ST-2 Training Schedule
3. ST-3 (L-003) Planting Plan
4. ST-4 (L-004) Planting Plan
5. ST-5 (L-0011) Irrigation Plan
6. ST-6 (L-0012) Irrigation Plan
7. ST-7 (C-4) Layout Plan
8. ST-8 C-4.1) Layout Plan
9. ST-9 (C-5) Grading and Drainage Plan
10. ST-10 (C-5.1) Grading and Drainage Plan
11. ST-11 (W-1) Utility Site Plan

12. ST-12 (W-1.1) Utility Site Plan
13. ST-13 (E-341) Site-Lighting Plan SHT.1
14. ST-14 (E-342) Site-Lighting Plan SHT.2
15. ST-15 (E-343) Site-Lighting Plan SHT.3
16. ST-16 (E-344) Site-Lighting Plan SHT.4

VOLUME 3

VOLUME 7 OPERATION AND MAINTENANCE REQUIREMENTS

Management Plan & Systems Operation and Maintenance Manual Templates Appendix A

Architectural Systems

Table of Contents

3.1 General Information

A. The Management Plan & Systems Operation Maintenance Manual Templates are a part of the comprehensive program for operation and maintenance of the US Army Criminal Investigation Laboratory. For detailed information of how this section fits into the overall documentation of a comprehensive operation and maintenance program, reference the following related documents.

1. VOLUME 7 - Operation and Maintenance Statement of Work
2. Appendix A – Management Plan & Systems Operation and Maintenance Manual Templates
3. Drawings and Specifications
4. Equipment Manufacturer's Instructions

B. This volume is not intended to replace contract documents, shop drawings, as-built drawings, or equipment manufacturers' instructions. The intent is to supplement such documents and provide an overall format for organizing the information necessary to operate and maintain the system.

C. For guidance in completing this volume, reference O&M SOW Chapter 1 – 'Statement of Work' and Appendix A Volume 1 – 'Comprehensive Management Plan'.

D. This building is designed to accommodate the crime lab in a building designed with life safety a major priority. Brick is the primary exterior material with glazing in curtain wall and painted metal elements. The structure is slab-on-grade with steel framing. The roof is a combination of built up roofing and metal standing seam roofing. The interior is finished with mostly lay-in ceilings, resilient flooring, and painted gypsum walls

E. This volume has been prepared for the maintenance personnel who will be responsible for the daily operation and maintenance of the building structures installed in the USACIL. The purpose of this volume is to familiarize maintenance personnel with the operation and maintenance of the building system at the USACIL, and to provide emergency and troubleshooting procedures.

3.2 Specific System Descriptions

A. Exterior Wall and Finish Systems

1. The primary exterior walls are non-load bearing red brick veneer attached to concrete walls, concrete masonry units, or cold-formed metal framing. The cavity walls are insulated with rigid board insulation, and the stud walls have unfaced batt insulation.
2. Metal-faced composite panels are used at soffit and wall areas adjacent to the glazed curtain wall. They are formed and fabricated for attachment with concealed fasteners. The joints are sealed with an elastomeric sealant.

3. An acrylic exterior finish system is used on the exterior ceiling outside the Bulk Evidence Processing Area.

B. Miscellaneous Metals

1. Stainless steel corner guards are used to protect external corners of ceramic tile and other interior finishes. Galvanized steel corner guards are provided on the exterior of the building in high traffic areas and loading dock areas subject to impact loads.
2. Hinged access doors are used to access hidden valves and controls that are behind gypsum walls or ceilings. The access doors are primed steel for field painting.
3. Galvanized steel ladders are provided to access the various roof areas. Ship's ladders and steel floor gratings provide an elevated catwalk in the Studio.
4. Corrosion resistant floor grating is provided in the chemical and flammable storage areas where spills may occur, and containment is a requirement.
5. Wire mesh partitions, including supports, mesh fabric, doors, and hardware are factory finished.
6. Extruded aluminum expansion joint covers are used in the walls, ceiling, roof and parapets for expansion control.
7. Galvanized steel handrails and guardrails are used at all steps and raised areas.
8. Pre-manufactured roof hatches are operable from the inside only and provide access to the roof. The hatch is equipped with an extension safety pole for safe access to the roof.
9. Guard posts or bollards are constructed of galvanized extra strong steel pipe and filled with concrete.
10. Safety nosings, consisting of cast aluminum or cast iron, provide an abrasive edge on the steps to prevent slipping and to identify each step.
11. Utility support framing consist of pre-finished cold-formed channels. They provide a uniform and clean appearance for the suspended building utilities within the labs at the steep sloped ceilings.

C. Roof Systems

1. The steep sloped roofs consist of aluminum standing seam panels. The panels are pre-finished and carry a 20-year warranty. The panels are green to match other metal roofs on the Base.
2. The flat roofs are 3-ply built-up roof over a modified bitumen underlayment. The roof system includes polyisocyanurate insulation, fiberboard overlay board, and aggregate surfacing material.

3. Miscellaneous roof components include mineral surfaced asphalt plank walkways, pipe supports, and EPDM membrane flashing.

4. Metal copings, metal fascia, scuppers, downspouts, gutters, and exposed metal trim are fabricated of pre-finished metal to comply with SMACNA. Concealed flashing, counter flashing, and other metal flashing on the roof shall be copper, stainless steel, or aluminum. Through-wall flashing consists of laminated copper or stainless steel.

D. Joint Sealants and Fire Stopping

1. Firestopping consists of manufacturer's proprietary systems designed to stop the spread of fire or smoke at through penetrations and joints in fire-rated assemblies. The firestopping manufacturer is required to design and detail each fire-rated condition for the project to comply with UL tested assemblies.

2. Joint sealants include elastomeric types per ASTM C 920 for control and expansion joints with 25 to 50 percent movement. Mildew resistant, structural silicone and acoustical sealants are used for specific applications. Latex sealant (caulking) is allowed only for cosmetic repairs in non-moving systems such as drywall. Elastomeric sealants are always used in sealed joints between dissimilar materials. A quality sealant installation always includes proper cleaning of the surfaces to be sealed, and the use of bond breakers.

E. Doors and Hollow Metal Frames

1. Interior doors are heavy-duty flush doors, and exterior doors are insulated extra heavy duty with welded seams. Door and window frames are pressed metal with welded corners for all openings. Bullet resistant components complying with UL 752 are provided at the Firing Range. All doors and frames are factory prepped for door hardware. Fire rated assemblies comply with NFPA 80. All exterior applications are fabricated of zinc-coated steel.

2. Overhead rolling doors and grilles are counterbalanced units with interlocking slats or curtains. Doors include motor operated, manual crank operation, fire-rated, insulated, and non-rated types. Doors are pre-finished powder coat and stainless steel as indicated.

3. Security vault doors are prefabricated units complying with GSA Class 5 standards. The vault door assembly includes frame, day gate, hardware, and electronic lock complying with FF-L-2740A. The record vault doors are fire-rated to comply with UL 155.

4. The revolving doors are special assemblies designed for darkroom installations. The units are light tight units consisting of inner and outer aluminum cylinders supported by a ball bearing center suspension. The units are wheel chair accessible. Accessories include internal handrail, finger grips, and fluorescent markers for visibility in the dark.

F. Door Hardware

1. All door hardware complies with ANSI/BHMA 156, NFPA 80, and NFPA 101 standards. Door hardware meets operational grade 1 and security grade 2. Cylinders and keying are by Best Corporation to be compatible with the Owner's existing keying system. A key control system is provided for 600 keys. Hardware finish is BHMA 630, satin stainless steel.
2. Electrified hardware such as electric exit devices, electric strikes, locksets, and magnetic locks are provided where card readers are needed for security.
3. Exit devices are concealed vertical rod type made of stainless steel.
4. Door closers are surface type with modern type covers, and are located on all corridor doors, fire-rated doors, and all exits.
5. Locks and latches are mortise type, heavy-duty with lever handles
6. Protective trim where noted shall be 1.6 mm stainless steel.

G. Glazed Curtain Wall System

1. The glazed curtain wall system consists of framing, glass, doors, gaskets, and all accessories furnished by a single manufacturer.
2. The glazed curtain wall system is thermally broken and exterior glazed. The aluminum framing components are factory finished with a two-coat fluoropolymer, high performance paint system per AAMA 2605
3. The individual windows are constructed with component to match the curtain wall system.

H. Glass and Glazing

1. Glass and glazing includes interior and exterior applications of insulating, laminated, spandrel, and safety glass, and combinations of each.
2. Insulating glass consists of dual-sealed units separated by an aluminum spacer. Laminated glass consists of two layers of float glass with a clear plastic interlayer.
3. Spandrel glass is coated with a colored ceramic material on the 4th surface.
4. Laminated insulating glass varies from dark green to clear, and is used throughout the curtain wall system.
5. Clear tempered glass is used for interior window and door applications.
6. Bullet resistant glass complying with UL 752 is used in the firing range area.
7. Clear tempered glass with sandblast surface is used in the lobby for the decorative art.

8. Wired glass is clear type II, mesh 2, used in fire-rated assemblies.

9. Mirror glass is type I transparent flat type, with silver coating, copper protective coating, and mirror backing paint.

I. Finishes

1. Typical interior partitions are constructed of light gauge metal framing supported by floor runner and deflection track attached to the structure above. Exposed gypsum panels are finished to a level 4 finish, and level 5 finish for walls painted with semi-gloss paint. Moisture resistant gypsum is provided in high humidity or wet areas. Fiber-reinforced gypsum panels are provided in areas requiring a higher degree of impact resistance. Sound attenuation blankets provide the necessary STC ratings where required.

2. Ceramic tile floors are installed over a depressed concrete slab in accordance with Tile Council of America tile setting method F114. All grout is epoxy resin meeting ANSI A118.3. Shower floors are waterproofed with sheet membrane.

3. Ceramic wall tile is applied over cementitious backer board, TCA method W244 using dry-set mortar or organic adhesive.

4. Terrazzo flooring is epoxy type conforming to National Terrazzo and Mosaic Association. The terrazzo is applied directly to a properly prepared concrete surface, and the concrete slab is installed over a reinforced vapor barrier to deter capillary water transmission.

5. Resilient flooring consists of sheet vinyl, vinyl tile, sheet linoleum, and related accessories.

6. Carpet tiles are adhered to the concrete slab with waterproof, pressure sensitive releasable adhesive. The carpet tiles are approximately 500 mm square.

7. The ceiling systems are suspended metal panels, acoustical panels, acoustical tiles, or gypsum board ceilings. Acoustical panels are installed in exposed grid, and acoustical tiles are installed in a concealed spline grid.

8. Painting includes general paint systems for ordinary use, and high performance coatings for moderate environments. The paint systems are classified by the Master Painters Institute for use on a particular substrate.

9. The paint schedules include Alkyd systems for concrete walls, metal surfaces, wood, and gypsum wallboard in selected areas.

10. Latex paints, in both eggshell and semi-gloss, are provided for the typical gypsum board walls in the offices and corridors.

11. High performance coatings, consisting of polyamide, polyurethanes, and waterborne epoxies are included for ferrous and non-ferrous metals, concrete masonry, and high impact gypsum walls. These systems consist

of a primer, intermediate coat, and finish coat. The systems are intended to perform for a period of 15 to 20 years with little maintenance.

J. Acoustical Wall Panels

1. Site fabricated wall panels consist of seamless polyester fabric cover over fiberglass or mineral fiber core.
2. The fabric is stretched over the core panels and secured in place by rigid vinyl extrusions.
3. The panels are durable, fire resistant, and provide a noise reduction coefficient in the range of .80 to .90.

K. Metal Wall Louvers

1. These consist of extruded aluminum units equipped with bird screens.
2. The louvers have drainable blades, and the units are factory painted to match the brick or the curtain wall as selected.

L. Modular Furniture Systems

1. The modular furniture is government furnished, contractor installed.
2. The system consists of fabric covered wall components, work surfaces, drawer units, overhead storage compartments, shelves, task lighting, and wire management system.

3.3 Theory of Operation

A. Exterior Wall Systems

1. The exterior walls function as a total entity from the inside face of the wall to the outside face. The walls are designed as the building envelope to provide insulation value, aesthetics, durability, and weather protection. The integrity of the wall system would be compromised if any component were omitted or damaged. Proper maintenance of the wall systems, therefore, is vital to the long-term performance of the facility.

B. Miscellaneous Metals

1. The miscellaneous metals serve individual purposes, but only function if installed properly and kept in good condition throughout the life of the facility. Metals are durable and designed to carry certain loads, without permanent deformation. Galvanized coatings and high performance paint systems applied to exterior metals prolong the life of the metal.

C. Roof Systems

1. The most noticeable feature on the building is the standing seam roof on the sawtooth elements. The green metal roof conforms to the other buildings on the Base.

2. The built-up roof systems generally require minimal maintenance during the operation of the facility.

3. Metal flashing systems and all the various roof drainage components serve to keep water out of the building, and to remove rain water from the roof surface as quickly as possible.

D. Joint Sealants and Fire Stopping

1. The joint sealants and fire stopping sealants work to provide the penetration closures throughout the building to stop unwanted air, moisture or insect penetration. The sealants must withstand temperature variations, different types of weather conditions, contraction and expansion of dissimilar materials, and building movement due to wind.

E. Doors and Frames

1. Doors come in a variety of shapes, sizes, and operational styles to serve the particular functions of the building. Swing type doors are customary for personnel use, whereas, roll up doors are better suited for transport of equipment and building supplies. Doors in essence provide passage through otherwise solid walls. The doors must undergo numerous opening and closing cycles, maintain fire ratings, afford security to the stored contents, and provide privacy to the occupants. In the labs, the doors must maintain the integrity of the enclosing wall construction.

F. Door Hardware

1. The hardware is specifically designed for each door according to its function.

G. Glazed Curtain Wall System

1. The glazed curtain wall system used on the exterior of the building is part of the building enclosure, functions as air and water barrier, transmits daylight to the rooms, and allows visibility to the outdoors.

H. Glass and Glazing

1. The various glazing types are used in specific situations for energy efficiency, security, bullet resistance, decoration, safety and vision.

I. Finishes

1. The interior of the building is designed to divide the spaces and enclose them. The drywall construction will enable the CIL to reconfigure most spaces in the future as the needs change. The floor, wall, and ceiling materials were selected for durability and practicality.

J. Acoustical Wall Panels

1. The acoustical wall panels are provided where sound absorption and noise control are necessary, such as conference rooms and training rooms.

2. The acoustical wall panels also function as a tackable surface for presentations and display.

3. The site-fabricated panels are not limited in size, and the system of components allows replacement of damaged fabric, or flexibility in redecoration.

K. Metal Wall Louvers

1. Wall louvers are provided to bring fresh air into the building for proper operation of the mechanical systems.

2. The louvers bring in fresh air, while keeping out large insects, birds, and rain.

L. Modular Furniture Systems

1. The offices and administration areas must allow flexible work environments due to frequent personnel changes and changes in the function of the rooms.

2. The modular furniture provides a higher density of occupants than fixed office space, and the open feel promotes a higher degree of interaction between the office personnel.

3. High performance work environments are both efficient and effective.

3.4 Operations

A. The contractor shall provide and incorporate the following information into this Section for each system identified in this Volume.

1. Operations: The operating instructions shall include system layouts showing:

a. Exterior wall system components

b. Miscellaneous metals operations manuals

c. Roof systems components

d. Joint Sealant locations and types

e. Doors and H.M. Frames types – linked with hardware

f. General Hardware locations and operating instructions

g. Glazed Curtain Wall System

h. Glass and Glazing location of types

i. Finishes locations

j. Modular Furniture

3.5 Preventive Maintenance

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Preventive Maintenance: Recommended procedures shall indicate PM (e.g., lubrication, checks, adjustments, etc.) and good-housekeeping practices which should be performed by operating personnel, as well as more complex maintenance procedures which would normally be performed only by trained maintenance personnel. The procedures shall be accompanied by a schedule indicating timeframes or operating hours for specific maintenance to be accomplished. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the maintenance procedures and flagged for the attention of personnel. The procedures shall include necessary operating instructions for taking equipment off-line, on-line, and putting equipment on standby. The instructions shall address all material, equipment, and system data needed to perform maintenance work and shall include, but not be limited to, manufacturers' bulletins, catalogs, and descriptive data; copies of approved test plans, including logs and records of performance acceptance test results and actual adjustments made during final acceptance and inspection; system layouts, including block, wiring, control, and isometric diagrams; schematic items within the facility; and interrelationships with other items of the system.

2. Schedules indicating timeframes or operating hours for initiating operator maintenance and adjustments and including manufacturer's recommended major maintenance requirements shall be provided. Emergency adjustments shall be included and flagged for the operator's attention. The instructions shall also include procedures for emergency repairs that could be performed by operating personnel.

3.6 Trouble Analysis

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Trouble Analysis procedures for locating and correcting the trouble shall be presented in a step-by-step format. Repair procedures shall be keyed to a troubleshooting guide outlined in three columns with the following headings:

Trouble/Symptom	Probable Cause(s)	Corrective Action
The indication or symptom of trouble	The instructions, including test hookups, necessary to determine the cause(s)	Procedures for restoring the system to operating condition, or cross reference to where the procedure is written in MP&SOMM

2. The procedures shall clearly indicate a major repair activity, which should be performed only in a shop or factory, as opposed to normal repair work, which may be performed on-site or with equipment online. The procedures shall also clearly indicate the limit of repair work that may be performed by maintenance personnel during the warranty period without voiding warranty provisions. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the repair procedures and flagged for the attention of personnel.

3.7 Corrective/Unscheduled Maintenance

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Corrective/Unscheduled Maintenance and Checkout Procedures: Procedures for troubleshooting and isolation, replacement, checkout, and integration of equipment within the system shall be provided.

2. Trouble Analysis: Procedures for troubleshooting of malfunctions that might occur during operation of the system shall be provided. Troubleshooting data, and fault isolation techniques, shall state the following:

   a. The indication or symptom of trouble;

   b. The instructions, including test hookups, necessary to determine the cause; and

   c. Procedures for restoring the system to operating condition.

3. Troubleshooting shall be documented to the extent necessary to locate the faulty piece of equipment within the system. Information may be in chart form, in logic tree form, or in tabular format with appropriate headings.

4. Isolation, Replacement, Checkout, and Integration: Procedures for isolation, replacement, checkout, and integration of the equipment within the system shall be provided. Test, adjustment, and checkout data, after replacement, shall be included.

3.8 Repair Parts and Special Tools and Equipment

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Repair Parts List: A complete list of repair parts and supplies shall be provided. The list shall include all parts and components of individual pieces of equipment and all parts and components of each system and shall identify such items as nomenclature of part, model number, circuit of component identification, etc. Parts and supplies lists shall be included within each volume of maintenance instructions. Further, a master list of repair parts and supplies recommended from each manufacturer for one year of operation, including source of supply, shall be sub-listed with each instruction. The Contractor shall also list the sources of supply for all parts and supplies, including name of supplier/manufacturer, address, and telephone number. If the parts and supplies are not normally stocked locally, necessary procurement lead-time shall also be a part of the listing.

2. Special Tools and Test Equipment List: A list of all special tools and test, measurement, and diagnostic equipment required for system level maintenance shall be included. For the purposes of this specification, the phrase "special tools and test, measurement, and diagnostic equipment" is used to identify all nonstandard tools and equipment designed and developed by the manufacturer and others to perform maintenance, test/calibration, diagnostic/prognostic analysis, and other related support of the equipment, as well as nonstandard tools required for installation, acceptance testing, and successful O&M. Frequency and method of calibration shall be indicated for all special tools, equipment and test equipment items that require calibration. Necessary standards shall be listed immediately after each item that requires calibration.

3.9 Vendor Data/Acceptance Tests

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Vendor Data: A complete set of data, provided by the equipment manufacturer, required for operation, maintenance and checkout shall be included and referenced to the appropriate specification number. Their data may consist of manufacturers' brochures, O&M manuals, catalogs, drawings, service bulletins, and illustrated parts lists necessary to support the O&M of the end item of equipment and assemblies.

2. A record of all Systems' Acceptance Tests shall be included in this section.

3.10 Warranty Information

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Warranty Information: In addition to the general warranty required and provided under the contract, the O&M manuals shall include any specific warranties required by other sections of the Technical Specifications and other warranties normally provided with the particular piece of equipment or system. Warranties that are normally provided by manufacturers and which are beyond the warranty for construction shall be specifically noted.

3.11 Design Master Equipment List

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. A completed master equipment list with guidance offered in Volume 1 - Comprehensive Management Plan. Exhibit MS-1 See information on the preparation of the Management Plan & Systems Operation and Maintenance Manual for further instructions on the preparation of this list.
2. Reference Exhibit AS-1. All manufacturer's data on the operation and maintenance of the equipment.

3.12 Training Requirements

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. A training schedule in accordance with guidance offered in Volume 1 - Comprehensive Management Plan.
2. Reference Exhibit AS-2 for guidance in the preparation of this schedule.

3.13 Exhibits

1. AS-1 Architectural Systems - Design Master Equipment List
2. AS-2 Training Schedule

B.

EXHIBIT AS-1 DESIGN MASTER EQUIPMENT LIST

Equipment Identification

SPECIFICATION PARAGRAPH NUMBER	DESIGN DRAWING NUMBER	LOCATION	TAG NUMBER	NOMENCLATURE	CHARACTERISTICS	ITEM MANUFACTURER	MODEL NUMBER	SERIAL OR PART NUMBER
08460-2.1				Automatic Sliding Doors				
08330-2.1				Overhead Rolling Doors				
11020A-2.1				Vault Doors				
11470-2.15				Revolving Doors				
08710				Electronic Door Hardware				

EXHIBIT AS-2 TRAINING SCHEDULE

SYSTEM:							
TRAINING TIME BY EQUIPMENT & EQUIPMENT SYSTEMS				Number of Hours		Schedule	
Specification Section	Equipment or Systems	Tag Number	O/M Staff Training	Classroom	Site	Planned	Actual
08330	Overhead Rolling Doors						
08460	Automatic Sliding Doors						
08710	Electronic Door Hardware						
11020	Vault Doors						
11470	Revolving Darkroom Doors						

VOLUME 4

VOLUME 7 OPERATION AND MAINTENANCE REQUIREMENTS

Management Plan & Systems Operation and Maintenance Manual Templates Appendix A

Security Systems

Table of Contents

4.1 General Information

A. The Management Plan & Systems Operation Maintenance Manual Templates are a part of the comprehensive program for operation and maintenance of the US Army Criminal Investigation Laboratory. For detailed information of how this section fits into the overall documentation of a comprehensive operation and maintenance program, reference the following related documents.

1. VOLUME 7 - Operation and Maintenance Statement of Work
2. Appendix A – Management Plan & Systems Operation and Maintenance Manual Templates
3. Drawings and Specifications
4. Equipment Manufacturer's Instructions

B. This volume is not intended to replace contract documents, shop drawings, as-built drawings, or equipment manufacturers' instructions. The intent is to supplement such documents and provide an overall format for organizing the information necessary to operate and maintain the system.

C. For guidance in completing this volume, reference O&M SOW Chapter 1 – 'Statement of Work' and Appendix A Volume 1 – 'Comprehensive Management Plan'.

D. The importance of the security systems cannot be overstated. The security system within the US Army Criminal Investigations Laboratory (USACIL) at provides protection for the physical structure and its contents and provides for the safety of the staff and visitors.

E. The security system is always on line and provides access control and alarm monitoring functions for the entire facility. For this reason, the security systems must be regularly inspected, tested, and maintained to ensure they are fully functional at all times.

F. This volume has been prepared for the maintenance personnel who will be responsible for the daily operation and maintenance of the building security systems installed in the USACIL. The purpose of this volume is to familiarize maintenance personnel with the operation and maintenance of the security system at the USACIL, and to provide emergency and troubleshooting procedures.

4.2 Specific System Descriptions

A. Access Control and Monitoring System

1. The facility is protected throughout by an ICIDS access control and monitoring system. The main computer or file server is located in the security monitoring room and a workstation is located in the Safety and

Security Office. The USACIL security officer shall authorize those personnel authorized to work on or maintain the system.

2. Remote Terminal Units (RTU) are co-located with the file server and provide remote data gathering for the system. All security devices are connected to the RTU's

3. A badging system is connected to the access system. User data is entered into the computer and a picture badge is generated which allows users access to various areas within the facility.

4. Alarm data received by the RTU's is sent to the file server and workstation and is annunciated on the terminals. The ICIDS system is connected to a government supplied J-SIIDS transmitter. Security signal transmission from the facility back to the MP station is provided through dedicated telephone lines from the transmitter located within the facility. The status of these telephone lines is monitored by J-SIIDS.

5. A visual alarm panel is located at the front of the facility. This map-based panel has LED's showing the location of alarm data. Responding MP or fire personnel use the panel to locate the alarm event.

B. Security Power System

1. The security power system consists of an uninterruptible power system (UPS) and power supply/chargers.

2. The UPS system provides continuous AC power to the file server and CCTV system. It is connected to the emergency power system and provides sufficient AC power to maintain operation of the system until emergency power is operational.

3. Direct current (DC) power supplies and chargers used to provide low voltage to all security related equipment. Separate supplies are used to provide power to electric door locking devices and card readers and sensors.

4. Alternating current (AC) power supplies are used to provide 24 VAC to closed circuit television cameras.

C. Closed Circuit Television (CCTV) System

1. The closed circuit television (CCTV) system consists of a digital recorder and cameras.

2. The digital recorder is programmed to record all of the connected cameras. Pre-event alarm recording is provided.

3. Cameras are both fixed and pan tilt zoom high-speed domes. Each camera is assigned a specific view for continuous monitoring. The cameras are interconnected to the access control and monitoring system. Alarm events trigger camera call ups to allow for more specific recording and assessment.

D. Vehicle Barriers

1. The vehicle barriers are hydraulically operated drop arms which provide crash resistance for a 30 MPH 4000 lb vehicle.
2. The barriers are interconnected to the access control and monitoring system allowing operation via card reader or selected intercoms. Upon presentation of a valid credential the gate is opened. The gate can also be operated via the door release feature of the intercom system. Exiting from the facility is triggered by vehicle loops and requires no card.

E. Intercom System

1. The intercom system is a video system allowing personnel inside the facility to communicate with and to view personnel outside the facility.
2. The main entry intercom is located at the front door and reception desk. The interior unit has a door release feature to allow for remote unlocking of the door.
3. The rear entry intercom is located at the vehicle gate and has a tow station call allowing the visitor to call either one of two interior stations. The two interior intercoms are located in rooms 904 and 915. The interior units have a release feature to allow for remote opening of the vehicle gate.

4.3 Theory of Operation

A. Access Control and Monitoring System

1. All security devices within the facility are connected to the system. The file server maintains databases of system events. All events are recorded in the databases and is available for printed reports or export to other application software.
2. Card readers control access to selected doors and only those personnel with valid credentials are permitted access. Attempted entry by an invalid credential generates an alarm. An internal sensor disables the magnetic contact for free exit without generating an alarm.
3. All other doors are equipped with magnetic contacts. The contacts monitor whether the door is open or closed. An attempt to enter or exit through these doors generates an alarm.

B. Security Power System

1. The security power system is designed to provide continuous power to all connected security devices.
2. The UPS is connected to the emergency power system and provides clean power to the connected file servers and CCTV recording equipment. Upon loss of commercial power, the UPS continues operation on its internal batteries and delivers 120VAC to connected devices.

3. The CCTV power supplies are connected to UPS circuits to allow for continuous monitoring in the event of a power outage.

4. The DC power supplies are connected to the emergency power system of the facility. Eight (8) hours of battery DC power is provided to allow the access control and alarm monitoring to continue full operation until power is restored.

C. Circuit Television (CCTV) System

1. The CCTV system is designed to monitor and record selected areas of the facility and grounds. Each camera is connected to the digital recorder via a fiber optic system.

2. The cameras are 24 VAC and are supplied with power via the security power system. Each camera is interconnected to the access control system to allow for alarm call-up. System set up procedures allow for defining alarm call-ups, pre-event recording time and length of recording. Under normal conditions, cameras are recorded at a specified level.

D. Vehicle Barriers

1. The vehicle barriers provide a barrier to entry for unauthorized. Only personnel presenting an authorized credential are permitted entry through the barriers. The barriers can also be control via the intercom system to allow personnel inside the facility to allow for delivery vehicles to enter without having to have an access control credential.

E. Intercom System

1. The intercom system is a hard wired system to allow two way audio and video communications between the slave and master stations. The slave stations are activated via a push button. The master stations are activated and two-way audio and video is provided. The master stations have remote release capability. This is connected to the access control system which in turns unlocks the door or raises the vehicle gate. The vehicle gate intercom is a two station master allowing multiple offices to control the gate.

4.4 Operations

A. The contractor shall provide and incorporate the following information into this Section for each system identified in this Volume.

1. Operations: The operating instructions shall include equipment and/or system layouts showing all piping, wiring, breakers, devices, controls, etc., complete with functional diagrams, schematics, isometrics, and data to explain the detailed operation and control of each individual piece of equipment and/or system, including system components. In addition to the above the following shall be incorporated:

4.5 Preventive Maintenance

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Preventive Maintenance: Recommended procedures shall indicate PM (e.g., lubrication, checks, adjustments, etc.) and good-housekeeping practices which should be performed by operating personnel, as well as more complex maintenance procedures which would normally be performed only by trained maintenance personnel. The procedures shall be accompanied by a schedule indicating timeframes or operating hours for specific maintenance to be accomplished. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the maintenance procedures and flagged for the attention of personnel. The procedures shall include necessary operating instructions for taking equipment off-line, on-line, and putting equipment on standby. The instructions shall address all material, equipment, and system data needed to perform maintenance work and shall include, but not be limited to, manufacturers' bulletins, catalogs, and descriptive data; copies of approved test plans, including logs and records of performance acceptance test results and actual adjustments made during final acceptance and inspection; system layouts, including block, wiring, control, and isometric diagrams; schematic items within the facility; and interrelationships with other items of the system.
2. Schedules indicating timeframes or operating hours for initiating operator maintenance and adjustments and including manufacturer's recommended major maintenance requirements shall be provided. Emergency adjustments shall be included and flagged for the operator's attention. The instructions shall also include procedures for emergency repairs that could be performed by operating personnel.

4.6 Trouble Analysis

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Trouble Analysis procedures for locating and correcting the trouble shall be presented in a step-by-step format. Repair procedures shall be keyed to a troubleshooting guide outlined in three columns with the following headings:

Trouble/Symptom	Probable Cause(s)	Corrective Action
The indication or symptom of trouble	The instructions, including test hookups, necessary to determine the cause(s)	Procedures for restoring the system to operating condition, or cross reference to where the procedure is written in SOMM

2. The procedures shall clearly indicate a major repair activity, which should be performed only in a shop or factory, as opposed to normal repair work, which may be performed on-site or with equipment online. The procedures shall also clearly indicate the limit of repair work that may be performed by maintenance personnel during the warranty period without voiding warranty provisions. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the repair procedures and flagged for the attention of personnel.

4.7 Corrective/Unscheduled Maintenance

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Corrective/Unscheduled Maintenance and Checkout Procedures: Procedures for troubleshooting and isolation, replacement, checkout, and integration of equipment within the system shall be provided.
2. Trouble Analysis: Procedures for troubleshooting of malfunctions that might occur during operation of the system shall be provided. Troubleshooting data, and fault isolation techniques, shall state the following:
   a. The indication or symptom of trouble;
   b. The instructions, including test hookups, necessary to determine the cause; and
   c. Procedures for restoring the system to operating condition.
3. Troubleshooting shall be documented to the extent necessary to locate the faulty piece of equipment within the system. Information may be in chart form, in logic tree form, or in tabular format with appropriate headings.
4. Isolation, Replacement, Checkout, and Integration: Procedures for isolation, replacement, checkout, and integration of the equipment within the system shall be provided. Test, adjustment, and checkout data, after replacement, shall be included.

4.8 Repair Parts and Special Tools and Equipment

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Repair Parts List: A complete list of repair parts and supplies shall be provided. The list shall include all parts and components of individual pieces of equipment and all parts and components of each system and shall identify such items as nomenclature of part, model number, circuit of component identification, etc. Parts and supplies lists shall be included within each volume of maintenance instructions. Further, a master list of repair parts and supplies recommended from each manufacturer for one year of operation, including source of supply, shall be sub-listed with each instruction. The Contractor shall also list the sources of supply for all parts and supplies, including name of supplier/manufacturer, address, and telephone number. If the parts and supplies are not normally stocked locally, necessary procurement lead-time shall also be a part of the listing.
2. Special Tools and Test Equipment List: A list of all special tools and test, measurement, and diagnostic equipment required for system level maintenance shall be included. For the purposes of this specification, the phrase "special tools and test, measurement, and diagnostic equipment" is used to identify all nonstandard tools and equipment designed and developed by the manufacturer and others to perform maintenance, test/calibration, diagnostic/prognostic analysis, and other related support of the equipment, as well as nonstandard tools required for installation, acceptance testing, and successful O&M. Frequency and method of calibration shall be indicated for all special tools, equipment and test equipment items that require calibration. Necessary standards shall be listed immediately after each item that requires calibration.

4.9 Vendor Data/Acceptance Tests

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Vendor Data: A complete set of data, provided by the equipment manufacturer, required for operation, maintenance and checkout shall be included and referenced to the appropriate specification number. Their data may consist of manufacturers' brochures, O&M manuals, catalogs, drawings, service bulletins, and illustrated parts lists necessary to support the O&M of the end item of equipment and assemblies.
2. A record of all Systems' Acceptance Tests shall be included in this section.

4.10 Warranty Information

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Warranty Information: In addition to the general warranty required and provided under the contract, the O&M manuals shall include any specific warranties required by other sections of the Technical Specifications and other warranties normally provided with the particular piece of equipment or system. Warranties that are normally provided by manufacturers and which are beyond the warranty for construction shall be specifically noted.

4.11 Design Master Equipment List

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. A completed master equipment list with guidance offered in Volume 1 - Comprehensive Management Plan. Exhibit MS-1 See information on the preparation of the Management Plan & Systems Operation and Maintenance Manual for further instructions on the preparation of this list.
2. Reference Exhibit SEC-1. All manufacturer's data on the operation and maintenance of the equipment.

4.12 Training Requirements

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. A training schedule in accordance with guidance offered in Volume 1 - Comprehensive Management Plan.
2. Reference Exhibit SEC-2 for guidance in the preparation of this schedule.

4.13 Exhibits

A. SEC-1 Training Schedule

B. SEC-2 (SCO3) – Security Plan Segment A

C. SEC-3 (SCO4) – Security Plan Segment B

D. SEC-4 (SCO5) – Security Plan Segment C

E. SEC-5 (SCO6) – Security Plan Segment D

4.14 Exhibit SEC-1 Training Schedule

SYSTEM: Fire Protection							
TRAINING TIME BY EQUIPMENT & EQUIPMENT SYSTEMS				**Number of Hours**		**Schedule**	
Specification Section	**Equipment or Systems**	**Tag Number**	**O/M Staff Training**	**Classroom**	**Site**	**Planned**	**Actual**
	Access Control an Monitoring System				8		
	Security Power Systems				4		
	CCTV Systems				2		
	Vehicle Barriers				1		
	Intercom System				1		
				Total	16		

Fire Protection Systems

Table of Contents

5.1 General Information

A. The Management Plan & Systems Operation Maintenance Manual Templates are a part of the comprehensive program for operation and maintenance of the US Army Criminal Investigation Laboratory. For detailed information of how this section fits into the overall documentation of a comprehensive operation and maintenance program, reference the following related documents.

1. VOLUME 7 - Operation and Maintenance Statement of Work
2. Appendix A – Management Plan & Systems Operation and Maintenance Manual Templates
3. Drawings and Specifications
4. Equipment Manufacturer's Instructions

B. This volume is not intended to replace contract documents, shop drawings, as-built drawings, or equipment manufacturers' instructions. The intent is to supplement such documents and provide an overall format for organizing the information necessary to operate and maintain the system.

C. For guidance in completing this volume, reference O&M SOW Chapter 1 – 'Statement of Work' and Appendix A Volume 1 – 'Comprehensive Management Plan'.

D. The importance of the fire protection systems cannot be overstated. The fire protections systems within the US Army Criminal Investigations Laboratory (USACIL) at Fort Gillem, Georgia, not only protect the physical structure from fire, but also safeguards the lives of the staff and visitors in a fire emergency.

E. Unlike other building systems, the fire protection systems are 'standby systems' - The systems do not function on a regular basis, but only operate in an emergency situation. For this reason, the fire protection systems must be regularly inspected, tested, and maintained to ensure they are fully functional at all times.

F. This volume has been prepared for the maintenance personnel who will be responsible for the daily operation and maintenance of the fire protection systems installed in the USACIL. The purpose of this volume is to familiarize maintenance personnel with the operation and maintenance of the automatic sprinkler systems and fire detection and alarm system at the USACIL, and to provide emergency and troubleshooting procedures.

5.2 Specific System Descriptions

A. Automatic Sprinkler Systems.

1. The facility is protected throughout with automatic sprinkler systems. The systems are composed of various and interconnected networks of piping, valves, controls, and sprinklers which provide water for fire suppression in a fire emergency. The systems are designed in accordance with the 1999

edition of NFPA 13, *Standard for the Installation of Sprinkler Systems*, and Military Handbook 1008C. Each system includes sensors, which interface with the facility's fire detection and alarm system to initiate occupant notification and emergency response activities.

2. The majority of the facility is protected by a wet pipe sprinkler system. The wet pipe system is divided into two zones, each protecting approximately one-half of the building. Each zone includes a manual control valve equipped with a valve tamper switch, a main drain valve, and a waterflow switch. The control valve, main drain valve, and waterflow switch are found on each zone's sprinkler riser, located in the mechanical room. Both the tamper switch and the waterflow switch are monitored by the fire alarm control panel.

3. A dry pipe system is provided for the bulk evidence processing area. The dry pipe system includes a dry pipe valve assembly with associated trim on the system riser. The dry pipe riser is located in the drying room, off the bulk evidence processing room. Air pressure is maintained in the system by a small, riser-mounted air compressor. A waterflow pressure switch is included in the alarm valve trim, and is monitored by the fire alarm control panel. The dry pipe system takes its water from the wet pipe system.

4. Double-interlock preaction systems are provided in the computer room, the SEM/EDX & XRD/XRF rooms, and the NMR laboratory. Each preaction system includes a deluge alarm valve assembly with associated trim on the system riser, as well as a system releasing panel located on a nearby wall. Air pressure is maintained in each system by small, riser-mounted air compressors. Waterflow pressure switches, included in each system's alarm valve trim, and system releasing panels are monitored by the fire alarm control panel. The preaction systems take their water from the wet pipe system.

5. Sprinklers have been located to provide complete coverage in accordance with NFPA 13. Sprinklers in the administrative office areas (generally in the front part of the facility) are ½-inch orifice, quick-response sprinklers. Sprinklers in the laboratory areas (generally behind the main corridor toward the rear of the building) are 17/32-inch, quick-response sprinklers. Depending on the location and type of ceiling in each space, sprinklers may be either pendent or upright styles. Dry pendent type sprinklers are provided in cold-storage coolers and freezers.

6. Each system is equipped with a drain and test connection, used to drain the system for maintenance purposes, or test the fire detection and alarm system's response to a waterflow signal. Wet pipe systems include the drain and test connection on the system risers. The dry pipe system includes a drain and test connection off the remote branch line near the

roll-up door. The preaction systems include a separate drain and test connection on the wall beside the riser.

B. Fire Detection and Alarm Systems

1. An addressable fire detection and alarm system (FDAS) is provided throughout the facility. The FDAS main fire alarm control panel (FACP) is located in the central electrical room; a remote annunciator panel is located behind the reception desk in the lobby area.

2. The FDAS is a fully addressable, intelligent system utilizing multiplexed communications. The system provides automatic fire detection and manual operation with general alarm via alarm notification appliances (horn/strobes) located throughout the facility.

3. Offsite annunciation is provided by transmission of a signal over the station radio fire reporting system via a Monaco BT2-4 radio transceiver.

4. The FACP provides alarm, supervisory, and trouble indications for the monitored systems. The FACP connects to the following devices in each fire alarm zone for monitoring, control, and communications functions:

    a. Manual pull stations
    b. Smoke detectors
    c. Heat detectors
    d. Duct smoke detectors
    e. Waterflow switches and pressure sensors
    f. Control valve tamper switches
    g. Preaction system releasing control panels
    h. Low air pressure switches
    i. HVAC shut-down devices
    j. Audible/visual indicating devices

5. Addressable and intelligent type photoelectric smoke detectors are located in the following spaces:

    a. Computer room
    b. SEM/EDX & XRD/XRF rooms
    c. NMR laboratory
    d. HVAC system ductwork

6. Addressable manual pull stations are provided at exits and in the path of egress in accordance with NFPA 101, *Life Safety Code®*, and are accessible to the disabled.

7. Fire alarm monitor modules provide an addressable circuit for alarm and supervisory devices that do not have integral address electronics; such as waterflow switches and control valve tamper switches.
8. Fire alarm control modules provide addressable relay control for magnetic door holder release and HVAC shutdown.
9. Visual and audible alarm notification is accomplished by wall mounted flashing strobe and horn devices.
10. The FDAS has automatic transfer battery standby power supply capable of operating the system for 24 hours in supervisory mode plus 5 minutes in alarm. The FDAS is connected to the life safety power system.

5.3 Theory of Operation

A. Automatic Sprinkler Systems

1. All sprinkler systems within the facility are designed with automatically opening sprinklers. As a fire grows, the temperature within the room or area increases. When the temperature at a given sprinkler reaches the sprinkler's temperature rating, the fusible link melts or the glass bulb breaks, thus activating the sprinkler. Upon activation, the sprinkler head opens and water sprays in the area of the open sprinkler. If the open sprinkler cannot control the fire, the temperature will continue to rise and additional sprinklers in the immediate area will operate, providing additional water to control the fire.
2. Each sprinkler system or zone is equipped with individual control valves to allow shut down of the water supply to the zone after a sprinkler activation and control of a fire. The control valve also provides a means for general maintenance or modifications to a sprinkler zone without shutting down sprinklers elsewhere in the facility. The control valves are equipped with tamper switches, tied to the FACP to annunciate a supervisory condition (closed valve). This helps ensure that the control valves are maintained in the open position (i.e., connected to the water supply) and not inadvertently left in the closed position.
3. Each sprinkler zone is equipped with a waterflow sensor. Wet pipe systems utilize a paddle-type waterflow switch, which senses the flow of water through the pipe. Dry pipe and preaction systems utilize a pressure type switch, which is activated upon a flow of water through the alarm valve and trim. Waterflow sensors are monitored by the FACP; when waterflow equal to a single open sprinkler is detected, an alarm signal is sent to the FACP. Because the dry pipe and preaction systems take their water from the wet pipe system crossmains, the FACP will indicate a waterflow condition in both the wet pipe and dry pipe or preaction system when either the dry pipe or preaction systems operate. It should be noted that the receipt of two waterflow indications (a wet pipe zone plus a preaction or dry pipe zone) is normal in these cases.

4. Wet pipe systems are designed to constantly contain water in the system piping for immediate release upon the opening of a sprinkler in response to a fire. When a sprinkler is activated by the heat from a fire, water is immediately available to discharge through the sprinkler orifice.

5. A dry pipe system is designed so that under normal conditions, only air is maintained in the system piping above the dry pipe valve. The air within the system is maintained at a specific pressure by the riser-mounted air compressor and air maintenance device. The air pressure presses down on the dry pipe valve's clapper, which holds back the water underneath. When a sprinkler is activated by the heat from a fire, air is released through the open sprinkler orifice. The air pressure in the system is subsequently reduced faster than the air-compressor can maintain. Eventually, the air pressure in the system cannot hold down the clapper against the incoming water pressure, and water flows into the system piping and out of the open sprinkler(s). Dry pipe systems are used in areas where pipe and sprinklers are exposed to freezing temperatures; for this reason, it is extremely important to properly and completely drain dry systems after water has entered, prior to re-activating the system.

6. Double-interlock preaction systems are also designed to maintain only air within system piping under normal conditions. However, double-interlock systems are utilized in areas where an accidental discharge of water could significantly damage or hinder operations within the protected area. Therefore, the clapper of a double-interlocked preaction alarm valve (deluge valve) is held back by two separate and independent means - specifically, the air pressure within the system piping, and a separate, physical locking mechanism. These two distinct barriers must each be released before water can flow into the system piping. The air pressure in the system piping will be released when a sprinkler is activated by the heat from a fire. (The air pressure may also be accidentally released due to a damaged sprinkler head.) The locking mechanism is released by a signal from the releasing control panel upon activation of a smoke detector located within the protected area. Only when both barriers or interlocks have been released will water flow into the system. As with dry pipe systems, double-interlock preaction systems must also be completely and properly drained after water has entered prior to resetting the valve and re-activating the system.

B. Fire Detection and Alarm System

1. The FDAS is designed to perform several functions:

   a. Fire detection via automatic detection and manual pull stations.

   b. Provide an audible and visual alarm throughout the facility to notify occupants of a fire condition.

   c. Automatically notify the post fire department.

d. Initiate various fire safety functions, i.e., shut down HVAC units, etc.

e. Monitor internal operation of devices or equipment (e.g., valve tamper switches).

2. Automatic fire detection is provided by:

a. Area smoke detectors located in rooms protected by double-interlock preaction systems.

b. Heat detectors located in the HVAC unit service corridors.

c. In-duct smoke detectors located in the supply and return duct of air handling units.

d. Waterflow detection devices located on each sprinkler system riser.

3. Manual fire detection is provided by manual pull stations located in the path of egress, typically at exit stair doors and exterior exits.

4. Activation of automatic or manual detection device will initiate an immediate alarm condition.

5. Upon receipt of an alarm condition, the FACP initiates an audible and visual alarm with horn/strobe units located throughout the facility.

6. Activation of a duct smoke detector or heat detector in the service corridor will shut down the associated AHU and supply.

7. The FACP provides self-diagnostic functions of missing device, open or grounded conductors, closed valves, AC power, and low battery voltage.

8. The FDAS is an addressable system where by each initiating device sends a unique identifiable address code to the FACP. The FACP is designed to recognize each address code and provide specific information concerning the indicating drive such as device type and specific location. The FDAS in-turn sounds the fire alarm and initiates various fire safety functions.

5.4 Operations

A. The contractor shall provide and incorporate the following information into this Section for each system identified in this Volume.

B. Operations: The operating instructions shall include equipment and/or system layouts showing all piping, wiring, breakers, devices, valves, dampers, controls, etc., complete with functional diagrams, schematics, isometrics, and data to explain the detailed operation and control of each individual piece of equipment and/or system, including system components. Layouts shall show the location within the facility of controls, valves, switches, dampers, etc., by reference to site location, room name and number, or other clear and concise directions for locating them. Operator data may be identical to posted data and framed instructions, but shall be prepared as a part of the O&M manuals. The instructions shall include:

1. Initial adjustments and control settings.
2. Precautions and pre-checks to be executed prior to startup of equipment and/or system, including safety devices, monitoring devices, and control sequence.
3. Step-by-step sequential procedures for startup and normal operation checks for satisfactory operation. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the operating instructions and fluffed for the attention of the operator. Procedures shall include test, normal, and automatic modes.
4. Procedures for normal and emergency shutdown of equipment and/or systems. The instructions shall include any procedures necessary for placing the equipment and/or system on standby or preparing the equipment and/or system for startup at a later time. Procedures shall include test, normal, and automatic modes.
5. Procedures for isolating individual equipment from the system and bringing individual equipment on line once the system is operating.
6. Operational logs and records requirements.

5.5 Preventive Maintenance

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Preventive Maintenance: Recommended procedures shall indicate PM (e.g., lubrication, checks, adjustments, etc.) and good-housekeeping practices which should be performed by operating personnel, as well as more complex maintenance procedures which would normally be performed only by trained maintenance personnel. The procedures shall be accompanied by a schedule indicating timeframes or operating hours for specific maintenance to be accomplished. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the maintenance procedures and flagged for the attention of personnel. The procedures shall include necessary operating instructions for taking equipment off-line, on-line, and putting equipment on standby. The instructions shall address all material, equipment, and system data needed to perform maintenance work and shall include, but not be limited to, manufacturers' bulletins, catalogs, and descriptive data; copies of approved test plans, including logs and records of performance acceptance test results and actual adjustments made during final acceptance and inspection; system layouts, including block, wiring, control, and isometric diagrams; schematic items within the facility; and interrelationships with other items of the system.

2. Schedules indicating timeframes or operating hours for initiating operator maintenance and adjustments and including manufacturer's recommended major maintenance requirements shall be provided. Emergency adjustments shall be included and flagged for the operator's attention. The instructions shall also include procedures for emergency repairs that could be performed by operating personnel.

5.6 Trouble Analysis

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Trouble Analysis procedures for locating and correcting the trouble shall be presented in a step-by-step format. Repair procedures shall be keyed to a troubleshooting guide outlined in three columns with the following headings:

Trouble/Symptom	**Probable Cause(s)**	**Corrective Action**
The indication or symptom of trouble	The instructions, including test hookups, necessary to determine the cause(s)	Procedures for restoring the system to operating condition, or cross reference to where the procedure is written in MP&SOMM

2. The procedures shall clearly indicate a major repair activity, which should be performed only in a shop or factory, as opposed to normal repair work, which may be performed on-site or with equipment online. The procedures shall also clearly indicate the limit of repair work that may be performed by maintenance personnel during the warranty period without voiding warranty provisions. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the repair procedures and flagged for the attention of personnel.

5.7 Corrective/Unscheduled Maintenance

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Corrective/Unscheduled Maintenance and Checkout Procedures: Procedures for troubleshooting and isolation, replacement, checkout, and integration of equipment within the system shall be provided.

2. Trouble Analysis: Procedures for troubleshooting of malfunctions that might occur during operation of the system shall be provided. Troubleshooting data, and fault isolation techniques, shall state the following:

a. The indication or symptom of trouble;

b. The instructions, including test hookups, necessary to determine the cause; and

c. Procedures for restoring the system to operating condition.

3. Troubleshooting shall be documented to the extent necessary to locate the faulty piece of equipment within the system. Information may be in chart form, in logic tree form, or in tabular format with appropriate headings.

4. Isolation, Replacement, Checkout, and Integration: Procedures for isolation, replacement, checkout, and integration of the equipment within the system shall be provided. Test, adjustment, and checkout data, after replacement, shall be included.

5.8 Repair Parts and Special Tools and Equipment

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Repair Parts List: A complete list of repair parts and supplies shall be provided. The list shall include all parts and components of individual pieces of equipment and all parts and components of each system and shall identify such items as nomenclature of part, model number, circuit of component identification, etc. Parts and supplies lists shall be included within each volume of maintenance instructions. Further, a master list of repair parts and supplies recommended from each manufacturer for one year of operation, including source of supply, shall be sub-listed with each instruction. The Contractor shall also list the sources of supply for all parts and supplies, including name of supplier/manufacturer, address, and telephone number. If the parts and supplies are not normally stocked locally, necessary procurement lead-time shall also be a part of the listing.

2. Special Tools and Test Equipment List: A list of all special tools and test, measurement, and diagnostic equipment required for system level maintenance shall be included. For the purposes of this specification, the phrase “special tools and test, measurement, and diagnostic equipment” is used to identify all nonstandard tools and equipment designed and developed by the manufacturer and others to perform maintenance, test/calibration, diagnostic/prognostic analysis, and other related support of the equipment, as well as nonstandard tools required for installation, acceptance testing, and successful O&M. Frequency and method of calibration shall be indicated for all special tools, equipment and test equipment items that require calibration. Necessary standards shall be listed immediately after each item that requires calibration.

5.9 Vendor Data/Acceptance Tests

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Vendor Data: A complete set of data, provided by the equipment manufacturer, required for operation, maintenance and checkout shall be included and referenced to the appropriate specification number. Their data may consist of manufacturers' brochures, O&M manuals, catalogs, drawings, service bulletins, and illustrated parts lists necessary to support the O&M of the end item of equipment and assemblies.
2. A record of all Systems' Acceptance Tests shall be included in this section.

5.10 Warranty Information

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Warranty Information: In addition to the general warranty required and provided under the contract, the O&M manuals shall include any specific warranties required by other sections of the Technical Specifications and other warranties normally provided with the particular piece of equipment or system. Warranties that are normally provided by manufacturers and which are beyond the warranty for construction shall be specifically noted.

5.11 Design Master Equipment List

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. A completed master equipment list completed with guidance offered in Volume 1 - Comprehensive Management Plan Exhibit MS-1. See information on the preparation of the Management Plan & Systems Operation and Maintenance Manual for further instructions on the preparation of this list.
2. Reference Exhibit FP-1. All manufacturer's data on the operation and maintenance of the equipment.

5.12 Training Requirements

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. A training schedule in accordance with guidance offered in Volume 1 - Comprehensive Management Plan.
2. Reference Exhibit FP-2 for guidance in the preparation of this schedule.

5.13 Exhibits

A. FP-1. Design Master Equipment List

B. FP-2. Training Schedule

C. FP-3. (F003) Life Safety Plan

D. FP-4. (F201-F207) Alarm Systems Section A-G

E. FP-5. (F101-F107) Sprinkler Systems Section A-G

5.14 Exhibit FP-1. Fire Protection - Design Master Equipment List

Equipment Identification

SPECIFICATION PARAGRAPH NUMBER	DESIGN DRAWING NUMBER	LOCATION	TAG NUMBER	NOMENCLATURE	CHARACTERISTICS	ITEM MANUFACTURER	MODEL NUMBER	SERIAL OR PART NUMBER
13930		Room 923		Wet-pipe Sprinkler Valve	System #1			
13851		Room 923		Wet-pipe Sprinkler Valve	System #2			
13851		Room 923		Fire Alarm Control Panel				
13945		Room 506		Preaction RCP				
13945		Room 506		Preaction Sprinkler Valve				
13935		Room 901		Dry Pipe Sprinkler Valve				
13945		Room 423		Preaction RCP				
13945		Room 423		Preaction Sprinkler Valve				
13945		Room 113		Preaction RCP				
13945		Room 113		Preaction Sprinkler Valve				

5.15 Exhibit FP-1. Design Master Equipment List

SYSTEM: Fire Protection							
TRAINING TIME BY EQUIPMENT & EQUIPMENT SYSTEMS				**Number of Hours**		**Schedule**	
Specification Section	**Equipment or Systems**	**Tag Number**	**O/M Staff Training**	**Classroom**	**Site**	**Planned**	**Actual**
13851	Fire Alarm System			8	20		
13930	Wet Pipe Sprinkler System				4		
13935	Dry Pipe Sprinkler System				4		
13945	Preaction Sprinkler System				8		

VOLUME 6

VOLUME 7 OPERATION AND MAINTENANCE REQUIREMENTS

Management Plan & Systems Operation and Maintenance Manual Templates Appendix A

Plumbing Systems

Table of Contents

6.1 General Information

A. The Management Plan & Systems Operation Maintenance Manual Templates are a part of the comprehensive program for operation and maintenance of the US Army Criminal Investigation Laboratory. For detailed information of how this section fits into the overall documentation of a comprehensive operation and maintenance program, reference the following related documents.

1. VOLUME 7 - Operation and Maintenance Statement of Work
2. Appendix A – Management Plan & Systems Operation and Maintenance Manual Templates
3. Drawings and Specifications
4. Equipment Manufacturer's Instructions

B. This volume is not intended to replace contract documents, shop drawings, as-built drawings, or equipment manufacturers' instructions. The intent is to supplement such documents and provide an overall format for organizing the information necessary to operate and maintain the system.

C. For guidance in completing this volume, reference O&M SOW Chapter 1 – 'Statement of Work' and Appendix A Volume 1 – 'Comprehensive Management Plan'.

D. The importance of the plumbing systems cannot be overstated. The plumbing systems include, among other things the laboratory waste, critical gases, domestic water, and sanitary drainage as well as the roof drainage scheme.

E. The plumbing system, although constantly in service, tends to be shielded from everyday viewing. For this reason, the plumbing systems must be regularly inspected, tested, and maintained to ensure they are fully functional at all times.

F. This volume has been prepared for the maintenance personnel who will be responsible for the daily operation and maintenance of the plumbing systems installed in the USACIL. The purpose of this volume is to familiarize maintenance personnel with the operation and maintenance of the plumbing system at the USACIL, and to provide emergency and troubleshooting procedures.

6.2 Specific System Descriptions

A. Criteria Listing

1. 1997 Uniform Plumbing Code (UPC).
2. NFPA 54 "National Fuel Gas Code"
3. NFPA 99 "Healthcare" to the extent that it covers non-medical breathing air and oxygen systems.

4. NCCLS National Committee for Clinical Laboratory Standards publication C3-A3 "Preparation and Testing of Reagent Water in the Clinical Laboratory"

5. ANSI Z-358.1 "American National Standard for Emergency Eyewash and Shower Equipment".

6. UFAS Uniform Federal Accessibility Standards, (for fixture arrangement).

B. Fixture Count and Population

1. The current fixture count for "domestic" fixtures, (as opposed to Lab sinks) covered by the Model Plumbing Codes. (See chart below)

Male	Admin. Core	3 WC	3 Lavs	2 Ur
Male	Lab Core	3 WC	3 Lavs	2 Ur
Female	Admin. Core	5 WC	3 Lavs	N/A
Female	Lab Core	4 WC	3 Lavs	N/A

2. The Uniform Plumbing Code fixture tables (UPC 1997 Section 413.0 and Table 4-1) base the fixture counts on the population and dictate that the male-female split must be 50-50. The fixture count listed above is capable of supporting a total population over 200 females; and a similar number of males.

3. The current toilet core layouts split the facilities to either side of the evidence vestibules, so that staff may reach the toilets without the extra step of the vestibule procedures. The result is to effectively provide near double the number of fixtures that would be required for the stated population.

C. Storm System, Roof Drainage

1. Design Criteria

a. In the 1997 UPC, the roof drainage system is based on a storm of 60 minutes duration, and 100-year return period; with an intensity for the Atlanta area of 89 mm per hour.

2. Roof Drainage Scheme

a. The roof system itself is better described under the appropriate Division 7 narratives, but for the purposes of addressing drainage systems, the drainage is configured approximately as follows:

b. An east-west separation occurs along the "H" line (running north south on the longest line of the building). Rain west of "H" drains to the dock area; rain east of "H" drains to the site system on admin east elevation. The areas between the "H" line and the clerestories has been altered, so that instead of sloping to east gutters it uses interior roof drains close to the "H" line. These roof drains drop internally and run underslab to exit on the east.

c. With the addition of interior drains, a secondary overflow system was needed. The secondary piping is sized for the same storm as the primary. The secondary storm leaders discharge North and South, on West half, an high above grade "to daylight".

d. Roof drainage to the west of the "H" line (towards the dock area) covers some 2 800 square meters (approx. 30,000 SF). This "rear" system slopes east to west to a continuous perimeter gutter drained by approximately 21 downspouts.

e. The pyramid shaped roof over the front admin area covers some 736 square meters, and also uses perimeter gutters and downspouts. A small "flat" roof.

f. For the perimeter primary system, the secondary system still uses an overflow weir at the downspout collector or spillover at the perimeter roof edge. There are presently no down-slope parapets in the scheme.

3. Sanitary Drainage Waste & Vent System

a. The "sanitary" drainage system collects soil and waste from conventional "domestic" fixtures (water closets, lavs, showers, etc.). This systems runs separate from, and using different materials than, the "laboratory waste" drainage system. These two systems (domestic and lab) do not join until after exiting the building as described below.

b. The sanitary will drain by gravity from the two main toilet cores to an underslab sanitary drainage system. No ejectors or other pumps are planned.

c. Mechanical room floor drains, drains to handle HVAC maintenance, and remote domestic fixtures (not in the two toilet cores) will also connect to the sanitary system.

4. Service Exit

a. Two main exits are indicated, one north and one south, on the front elevation. Preliminary drainage calculations indicate approximately 220 drainage fixture units at each exit. Each exit is expected to be 150 mm. Inverts are set to minimize ledge excavation

5. Piping materials

   a. Sanitary DWV and soil pipe will be limited to cast iron (CI) in sizes 75 mm and larger, with copper drainage DWV tubing for wastes and vents 75 mm and smaller. 50 mm Cast iron can be used for venting.

   b. Below grade sanitary drainage is generally limited to cast iron, and all buried cast iron will be jointed with bell and spigot gaskets. CI used above grade may be jointed with either gaskets or "no-hub" joints; lead joints will be prohibited for environmental reasons.

6. Slope

   a. The drainage system is intended to run at 2% slope where practical, and 1% slope minimum

7. Domestic Water Systems

   a. Domestic Supply

      1. The building domestic water supply will enter the Mechanical Room on the southwest face of the building, parallel to and close to, the Fire Protection water supply. The services will come into what is the north wall of the mechanical plant. Racked on this Northwest wall in the plant will first be the Fire Protection riser, then the wall-mounted backflow devices for the domestic and laboratory water supplies.

      2. First, the domestic service will pass through a duplex reduced pressure backflow preventer (RPBP) station (protecting the base from the building). Instead pretreating for the pure water (RO) system, the mm assembly will filter <u>all</u> building water.

      3. Another rack of RPBP's will subdivide the 100 mm supply into domestic and laboratory services (protecting the people from the processes, and the evidence from the domestic systems).

   b. Water Distribution

      1. The laboratory stream (called "Protected") will feed the Laboratory demands. The purely "domestic" cold water stream will continue on to feed toilet cores, drinking fountains, hand sinks, and emergency shower safety stations.

      2. The northwest service corridor parallel to column line "C" is the main distribution rack for hot and cold water, protected hot and cold, pure water and bulk gases. Between

column lines 10 and 11, the "domestic" supplies to the Administration area will branch off to the east.

c. Water Heating

1. The building uses gas-fired storage water heaters, duplexed, in the central Mechanical plant, to provide domestic and protected recirculated hot water loops to the fixtures and to the labs, respectively.

8. HVAC System Support Systems

a. Mechanical System Water Makeup

1. A dedicated branch on the east wall of the cup. with a reduced pressure backflow preventer provides a non-potable (NPW) stream to the chemical treatment area at the heating boilers, and to the makeup stream for the cooling towers. A sanitary drain riser will reach to each of the main rooftop AHU's for drain-down and spill-protection purposes.

b. Humidifier Pretreatment

1. To support the humidification of HVAC air streams, the Total Dissolved Solids (TDS) levels of the incoming water supply will be reduced to prevent scaling and precipitates in the humidifier and the supply ductwork.

2. A clean compressed air stream will atomize the treated potable water as described in the HVAC section of this submission. This stream is identified on the plumbing drawings as "HS" for humidifier supply; it is limited just off, and runs to the 5 rooftop AHU's, the west service corridor.

c. Environmental Room Backup

1. Walk-in cold rooms do not require emergency cooling water.

d. Plumbing Fixtures and Equipment

1. Plumbing fixtures are standard commercial grade vitreous china with hands-free infrared flush valve operated wall mounted Water Closets and Urinals; and countertop or wall hung lavs.

2. Plumbing fixtures will conform to the accessibility requirements of Federal Standard 75: Uniform Federal Accessibility Standards (UFAS).

3. Water conservation will be achieved by utilizing plumbing fixtures that are self-metering, contain flow restrictors, or are low flow by design. Water closets will be low flow, 6 liters per flush; urinals 3.8 liters per flush; and lavs approximately 2 liters per minute. Water closets, Urinals and Lavatories are "hands-free".

9. Emergency Safety Stations

a. Laboratory Safety Stations

1. In the Lab Divisions, combination emergency shower/face and eyewash stations will be provided.

2. The safety stations are fed by domestic water from alarmed tempering valve cabinets in the service/evidence corridor, at approximately 30 degrees C. The intent is to provide an area alarm, as opposed to individual station alarming. Floor drains are provided at all emergency shower stations. Three safety mixing valve cabinets (SMV) are used to provide the tempered water (TW) supplies to showers and drench hoses. One serving, serology and firearms; one serving question documents and trace; and one for latents, imaging and evidence handling.

3. Inside the labs, casework mounted stay-open eyewash and drench hoses will be incorporated into the benchtop services, with spacing appropriate to the layout, function and population of the individual spaces. The supply will be tempered domestic water at approximately 30 degrees C.

10. Fuel Gas System

a. Site Natural Gas

1. The site is served by a central natural gas grid at 30 psi which will be tapped and brought into the West side of the Mechanical Plant south of the loading dock.

2. On the "house" side of the Gas meter and PRV, the building gas system will be run into the Mechanical Plant in schedule 40 A53 carbon steel; welded as appropriate for the pressure class.

3. The site natural gas system is "backed up" by a central propane/air plant on the Base. The fuel gas site service (30 psi) to the Post is provided by "Atlanta Gas and Light".

4. The line from the "street" to the "Meter Rack" is a gas-grade polyethylene, 65 mm, non-ferrous service.

5. The USACIL "owns" the system at the "house-side" of the meter, rack. The service enters the "CUP" and then splits into a 5 psi boiler supply and a Ø.5 psi service for water heaters and lab outlets.

b. Gas Loads

1. The gas load for the heating boilers is shown on panels with another load for water heating for domestic and lab hot water. The controlling demand for domestic is the hot water side of the tempered water for safety stations. Lab gas outlets are mostly limited to classic fumehood trim.

11. Labwaste Monitoring

a. The elements of the Labwaste system

1. The Labwaste (LW) system is gravity-only.
2. Bring in a dilution stream; (e.g. water treatment reject stream) if possible.
3. Monitor the pH in the "dilution" tank (to inform the WWTP), before joining the site sanitary.
4. LW pH monitors read and alarm to two monitoring panels in the BAS room.

b. The monitoring manholes are indicated on the Plumbing drawings, one north and one south of the east Admin entrance

c. The monitoring manhole remains nothing more than a "running trap" with pH probes recording pH for alarm/data acquisition. The structure needs only be big enough to provide safe access for maintenance and inspection. A product data sheet is included; the final detail is poorly represented, if at all.

12. Laboratory Waste (LW) Piping

a. Lab waste (LW on the drawings will run buried, without trenches in the slab. Spare LW runouts will be provided capped at the floor for future flexibility.

b. Piping materials

1. Enfield; Orion or Sloan-Fisher Labwaste polypropylene (PP) product lines.
2. Schedule 40, fused joint PP below grade, normally
3. Schedule 80, fused joint PP below grade if any elevated temperature streams are expected.
4. Non-fire retardant PP below grade.
5. Fire retardant PP above grade.

6. Fused joint concealed above grade.

7. Mechanical joints at casework, and at most exposed above grade locations.

13. Silver Recovery

a. Local silver recovery is planned, above floor, and dedicated to the film processes. The treated discharge would then go to the Labwaste drainage system.

14. Laboratory Compressed Gases

a. Bulk

1. Lab compressed air, Lab Vacuum, Nitrogen (99.995) and low pressure natural gas are all central systems originating in the CUP (Mechanical Room).

b. Satellite

1. Helium, Argon and P10 mix of Argon and Methane, are all fed from cylinder racks in the Lab corridor. These services will run in stainless steel tubing to point-of-use panels within the labs.

2. The cylinder rack spaces (in groups of six) are expandable and can be reconfigured.

c. Helium

1. Trace Evidence: 60 cyl per year for 8 instruments. Helium needed in Arson MSD, Instrument room, SEM rooms and Application Development space.

2. Drug Chemistry: 26 cyl per year for GC, and GC/MSD. Liquid Helium is needed to initialize the NMR, but will not be a sited system.

d. Hydrogen

1. Trace Evidence: 12 cyl per year (assume for FID's). Will switch to Whatman/Spectra H2 generators, no cylinder space required. Two generators (GFGI) are planned for the equipment room

2. Drug Chemistry: used for FID (Flame Ionization Detectors) same volume yearly as Trace, supplied by generators that are in turn fed by the bulk pure water system. The summary table reviewed gives 1 cyl per year for each unit, while the Trace estimate describes 12 cyl per year. In any event, one 500 ml generator can usually supply 10 or more FID's.

3. Hydrogen piping is not shown on the plans, because H2 is not to be piped from room too room, only from the generator to the use panel.

e. P10 – (Argon/Methane mix)

1. Trace Evidence: 4 cyl per year. P10 is a mix of 10% methane and 90% Argon, used for Xray fluorescence, and here listed as for Scanning Electron Microscopy.

2. Drug Chemistry: not used

f. Argon

1. Trace Evidence: 15 cyl per year. Ar is used in AA (atomic adsorption spectroscopy) and in the Application Development space. If the ICP is "Argon Plasma" the Argon cylinder space may expand into the spare storage racks.

2. Drug Chemistry: not used.

g. Zero Air

1. Trace Evidence: Compressed air of a quality appropriate to supply a generator to establish a proper baseline with H2 in an FID. This would be generated from the bulk Lab CA system, similar to the H2 generators, and these units will be matched up for the FID's. Trace uses 12 cyl per year (in the Trace summary) or 6 cyl per year in the consolidated summary. The difference may be in correcting for bottle size.

2. Drug Chemistry: the BA or CA requirement is identified as an input to a zero-air (ZA) generator. In the consolidated summary reviewed, Drug uses 4 cyl per year, to Trace's 6 cyl. Again, the local ZA generators will be matched to the number and location of H2 generators and FID's.

h. Nitrogen (N2)

1. A bulk nitrogen (N2) gas system will be centrally piped to the labs, from a leased liquid source at the south end of the "rear" loading docks. Clean copper tubing (washed bagged brazed) is appropriate for the bulk N2; which would typically be at 99.995% purity from the liquid evaporator. Higher grades of nitrogen could be from cylinder racks in the lab corridor to the instruments, with the option of adding a gettering nitrogen purifier to the point of use.

2. Trace Evidence: N2 usage is 30 to 45,000 CF every two weeks in gas boiloff form. The liquid form will be needed

for the SEM room, Xray Fluorescence, and AD. A leased LN2 tank with both liquid and gaseous output is presently programmed for the south end of the rear dock near the mechanical plant exterior entrance. This usage volume suggests a 900 gallon LN tank, with approximately two months supply. A representative (GFGI) LN tank arrangement is attached.

3. Drug Chemistry: Needs N2 for FTIR (Fourier Transform Infrared Spec), for GC's, for special applications, and as a liquid for NMR filling.

4. Imaging color processor: This application will need at least one 300 CF cyl of Tech grade N2 per year, with pressure regulating panel, same as all gas cylinder racks.

i. Compressed Air (CA)

1. (Dry, clean, oil free) will be a bulk service, defined as 'Laboratory CA'. The current scheme is to use the central mechanical plant compressors and "polishing" the air stream for the laboratory bulk system. This stream will be suitable for most Laboratory uses, with further polishing at Zero-Air generators for specialized uses (e.g. FID's).

2. A second stream is shown on the drawings as "CA7", meaning compressed air at a pressure of 7 bar (100 psi). This stream is intended for tool and motive use, and can be of lesser quality.

j. Rare Gases

1. Xenon and other "lecture bottle" sized gases should be as close to the process as possible.

k. Natural Gas

1. The programmed fumehoods and lab benches indicated "Bunsen-burner" type gas services in the Labs, more than was expected at Code 3. A 14 inch w.c. system (100,000 BTUH) has been added.

l. Vacuum

1. Not the subject of equipment roughing pumps, these hood and benchtop inlets are setup for the traditional 15 to 18 inches of mercury vacuum. The central Lab Vacuum pump set is duplexed and expandable with two 2HP rotary vane pumps.

D. Central Pure Water System

1. Bulk (baseline) pure water - ROS/ORP

2. Process-specific pure water - GFGI/UPW

3. A central [NCCLS] Type II pure water system will take the incoming supply up to a purity of approximately 2 to 10 megohms. The treatment train will consist of:

   a. A single Multimedia Filter (upsized and moved)

   b. Duplex Water Softeners

   c. A Carbon Filter

   d. Duplex Reverse Osmosis modules (one Lab on HS)

   e. Central Storage vessel (750 gal)

   f. Smaller RO

   g. Repressure and distribution pumps

   h. Mixed Bed or Continuous Deionization (CDI)

   i. Ultraviolet sterilization

4. This treatment train would be rated at approximately 19,000 liters per day, with most of the production in approximately ten hour off-peak cycle. A 5 gpm throughput would produce this result, with a 4 gpm product after reflection losses.

5. RO for Humidication

   a. The rooftop AHU's require a humidifier water supply, totaling 7 gpm, to be atomized into the airstream (in the "winter").

      1. Treatment unit "RO2" takes a stream off of the RO Process before chlorine is removed by the carbon column.

6. RO Piping Materials

   a. The product water would be circulated (supply and return piping) in inert unpigmented polypropylene tubing.

   b. The supply and return loops run in the main Lab corridor, and are balanced at takeoffs to each Laboratory group. The distribution within the Lab suites is a continuous loop.

7. Water Chemistry

   a. The Clayton County Water Authority report on water quality indicates that total hardness is between 20 and 50 milligrams per liter (1 to 3 grains per gallon), and total dissolved solids (TDS) is approximately 75 mg/l.

   b. The parameters of CAP Type II (College of American Pathologists) water specifications for the baseline system (standardized as NCCLS) will be:

1. Resistance = 2 megohms/cm at 25 deg C
2. Silica = 0.1 mg/liter
3. Heavy Metals = 0.01 mg/lit
4. Potassium permanganate reduction = 60 minutes
5. Sodium = 0.1 mg/liter
6. Ammonia = 0.1 mg/liter
7. Microbiological Content = 1000 CFU/ml
8. pH is not specified
9. CO_2 = 3 mg/liter

c. At the laboratory bench, a bench or umbilical-mounted Point of use purifier will polish the Type II specifications up to Type I.

6.3 Theory of Operation

A. Laboratory Vacuum System

1. The central laboratory vacuum system consists of three major components.
   a. The duplex vacuum pump package in the central mechanical plant.
   b. The distribution piping network.
   c. The terminal bench and fumehood outlets
2. The skid-mounted vacuum pump set contains two oil-flooded pumps, vertically stacked, with an expandable frame. A third pump can be added to the top of the support frame, allowing for future expansion of the system. The pumps use rotary vanes sealed by a synthetic oil that can resist the effects of mild chemical vapors.
3. Each pump will displace approximately 28 cubic feet per minute, pulling a vacuum of about 25 inches mercury. The setting of the vacuum level is adjustable at the control panel on the skid. A common setting is between 20 and 25 inches mercury. Higher level settings, approaching 29 inches, are not appropriate for this type of system; those levels (called High-Torr, or HiVac) are achieved by the specialized pumps associated with specific Lab equipment.
4. The vacuum system can operate in manual or automatic mode, selected at the control panel. In automatic mode, the programmable controller will decide which pump is the “lead” pump. The pressure switch P1 will activate the lead pump when the system pressure is below the “on” setting. When the system pressure (vacuum) is restored, the pump will shut off, and the “lead” pump will become the “lag” pump so that they both get approximately the same hours of running. If the first pump

cannot keep up with the demand, the second pump will join in to restore the vacuum level.

5. The piping network extends from the central mechanical plant to Fumehoods and bench outlets in the Labs. Each of the major Lab discipline areas can be isolated from the main corridor vacuum piping without affecting other Lab units.
6. The piping is a smooth copper tube, and is inherently "dirty" due to its function. The tubing connects to a central receiver where liquids are collected and discharged to the Laboratory waste piping system.
7. The vacuum outlets are more correctly "inlets" because of the direction of flow. The most common inlet is the classic Fumehood serated "cock" built into the hoods. The vacuum level will decrease over the length of the piping system, and hood inlets will have vacuum in the range of 15 to 19 inches mercury, depending on the central pump setting.

B. Laboratory Waste System

1. The Laboratory Waste (LW) system is a network of mostly underground drainage piping. This gravity drainage system uses corrosion resistant polypropylene piping with heat-fused joints. The Labwaste piping is separate from the standard domestic drainage piping system that serves toilet rooms, showers, and other non-chemical flows.
2. The Labwaste drainage exits the facility in two points north and south of the front entrance to the Lab. Here the separate waste lines enter Monitoring manholes that each contains a pH monitoring assembly. The pH monitor is an inline probe that relays the pH reading of the waste back to digital panels in the BAS room. These panels will keep a history of the pH so that any "spikes" in the labwaste pH can be investigated.
3. The waste stream then runs from the monitoring manhole to join the "sanitary" waste stream at an adjacent site manhole. The expectation of the program is that the LW stream will be diluted in the mixture before heading for the Fort Gillem wastewater treatment plant. The monitoring system will keep digital records of the LW pH, and can be set to alarm in the BAS room if the pH gets too far "out of range".
4. If the chemical wastes are ever found to cause issues for the waste treatment plant, the Labwaste system can be modified to include either chemical injection, or fresh water dilution. Since fresh-water dilution is an environmentally sensitive subject (that is, a water conservation concern) dilution should not be the default solution.
5. The two waste streams (sanitary and labwaste) follow a basic rule that clear water wastes may go into the Labwaste (LW) system, but that LW may not go into the sanitary. For example, a drain at the vestibule handwash sink could go into either system; but a drain at a labsink can only go into the labwaste system.

6. There are no pumps in the Labwaste (or Sanitary) drainage system; all flow is by gravity, and does not rely on power or automatic equipment. No user intervention should be required.

C. Water Supply System

1. The water supply entering the Central Mechanical Plant (Room 923) is filtered before flowing to the various water systems. Normally, this multimedia filter is used only as the first 'pretreatment' device in the pure water system; usually <u>not</u> as a filter for the entire building.

2. Since existing USACIL facilities reportedly have had excessive water filtering issues, the initial Multimedia filter (MM) was moved 'upstream,' so that it will serve <u>all</u> water flow into the building, except fire protection. With the site infrastructure improvements programmed, this may turn out to be overkill (say ten times as large a multimedia filter as for RO only) if the delivered water quality does improve during construction.

   a. The initial separation of the water tower supply into fire service and domestic service occurs on the site network. The fire and domestic services enter the building separately. This article describes the domestic system only, not the fire protection.

   b. At the water service entrance, the domestic supply first passes through the "Building" backflow preventers. This first station prevents any water inside the lab from backflowing into the 'public' supply. In other words, it protects the public from the lab operations.

3. Separation of Water Streams - The supply then splits into two separate streams

   a. Laboratory water system

   b. Domestic ('Potable") system

4. The laboratory supply is labeled as "Protected" as in 'PCW.' 'Protected' refers to the second set of backflow devices protecting the non-lab (kitchen, water coolers, showers) uses from the lab operations.

5. The 'protected' system is not necessarily any different in quality from the 'potable' stream, but the presence of aspirators, equipment connections and other 'hazards' dictates the separation.

6. To summarize these streams:

   a. Water tower supply splits into "Fire" and "Water."

   b. All "Water" passes through an isolating (one way) backflow preventer.

   c. Water" splits into "Lab" stream and "Domestic" stream.

d. All lab (protected) water passes through an isolating (one way) backflow preventer.

7. The Public is then isolated from the building and the potable uses are isolated from the lab. The physical separation of the network can be seen on the drawing; the 'Admin' space is on the domestic potable system (same code and controls as your home), while the lab system is isolated. This adds protection for the USACIL personnel from their own lab operations.

8. The only 'potable' system inside the Laboratory spaces (that is, past the vestibules inside the Investigators work areas) is the Emergency Shower and Eyewash system. These showers are on the same 'branch' as the showers in the Admin locker rooms.

9. The domestic (potable) stream (CW) diverges once again where it divides into cold, hot and recirc (CW, HW & HWR).

10. The 'protected' system branches again a few more times (using backflow assemblies) to 'protect' labs from CUP operations, or from "RO" process functions. In all of these branchings, the logic is:

a. Protect the Public

b. Protect USACIL staff

c. Protect the evidence

11. These water streams and isolating devices are purely mechanical "background systems" that rely only on the height of the water tower and the basic physics employed in the devices. No user intervention is required; there are no adjustments needed, just appropriate testing.

D. Pure Water System

1. The central pure water system in the main mechanical room is meant to take the incoming Clayton County water supply, and process it to change the water chemistry to produce what is called a "Type II" water supply for general laboratory use.

2. RO (or RODI) is the acronym representing the Reverse Osmosis and DeIonization processes that do most of the treatment.

3. The process can be divided into pretreatment, treatment and polishing.

a. The beginning of the pure water train is "Pre-treatment" to prepare the feedwater for entry to the RO units. Pretreatment uses a multimedia filter (much like a sand filter) to take out the 'large' particles of dirt and suspended solids in the supply. Cartridge filters then catch the media that might carry through. Softeners then use ion exchange to 'grab' Calcium, Magnesium (hardness) and similar hard ions in the stream. These ions are replaced bu sodium from the exchange resins

b. If the water source is mostly subterranean, the supply will be 'harder' than open lakes and reservoirs. When the resins capacity to supply sodium is used up, they are rejuvenated by the brine solution.

c. The controls will automatically handle the brine regeneration and backwash on a timer (usually weekly). Because this operation is automated, there are two softeners, so that laboratory processes are not interrupted.

d. The feed water will now still contains silica, manganese, chlorine and some biological contaminants. The final major pretreatment vessel will remove the chlorine by carbon absorption before entering the RO units. This single vessel contains carbon granules with an affinity for free chlorine. These granules (some made from coconut shells) can perform their duty for many years without replacing the media; but since they also capture smaller suspended solids, it needs to be backwashed periodically to flush out these particles. Since the carbon column is not very "time sensitive", it can be flushed manually off-hours and does not need duplexing.

e. The feedwater then moves on to the "Treatment" stage in the train. There are two RO units: one to make the lab pure water and one to make the water stream for the humidifiers

f. These two differ in operation: the lab pure water does not want to see the chlorine, but the humidifiers are going to want chlorine to lower bacteria in the humidified (potable) air stream. So the humidifier stream (HS) bypasses the carbon unit and uses chlorine resistant membranes. The HS line then goes directly to the rooftop air stream humidifiers. RO is one of the only processes that can reduce totally dissolved solids (TDS) that cause humidifier problems. Along the process ultraviolet light is used to address remaining bio-content.

g. Free chlorine is now gone and the RO unit forces the feedwater through the thin film membranes. Part of the feed to the lab RO unit is rejected; some % containing rejects then goes to sanitary drains.

h. The process then moves to DI (actually CEDI) using continuous electrical deionization (ion exchange) as opposed to physical anion and cation media.

i. Again, UV and ultrafilter (we are getting smaller and smaller here) equipment precede the storage tank. At the RO (or RO-CEDI) tank, all water pressure is gone and pure water pumps are needed to distribute the product to the labs.

j. To minimize bio-grout in the storage tank and beyond, the tank is inerted with 4-mines nitrogen. UV and ultrafilters are also employed.

k. The RO distribution process is aimed at maintaining a specific velocity of the purified water. If the distribution system can keep the velocity up, the flow will be turbulent and this reduces bio-film growth on pipe walls and fittings. Each lab unit has a continuous loop and each unit has a corridor connection that can be isolated and balanced.

l. The limiting flow element is the RO unit itself. It can only process about 4 or 5 gpm, 240 gph or 5,760 gpd. One of the possible approaches is to program the system fill up the RO Tank off-hours. That is, run the RO-CEDI system for ≤10 hours overnight and have a “ready supply” in the morning. The recovery capacity should keep up with the loads if the loads are timed. If everyone comes in at the same time and then immediately applies their heaviest loads, the system may fail.

m. The system is Type II because Type I is too expensive, too complex and too difficult to document. Instead the final point of use (POU) Type I filters should be under the control of the investigator, not dependent on the CUP.

E. Emergency Eyewash/Showers

1. The shower/eyewash stations (13 or so) and the handheld eyewashes in the lab benches are fed from a dedicated safety mixing valve (SMV) cabinet in the main lab corridor. The cabinets enclose tempering valves that mix hot and cold domestic water to produce tempered water at about 85°F.

2. The tempered water follows OSHA’s suggested rules (they call it tepid) for reducing the shock to the user from the cold water while reducing the danger of scalding. The mixing valve is similar to a good single handle balanced shower valve in your home. If there is a failure in the system, it fails to cold.

3. The SMV cabinets are closer to the chemical use areas (not Questioned Documents for example) and there is some overlap between investigative teams. The cabinets are alarmed so that any use or test of emergency stations will sound an alarm for the zone. This is important because using a drench hose/eyewash at the lab bench will set off horns and lights in the corridor. The maintenance program for the facility will do these tests silencing alarm functions while supervised. The cabinets are capable of tying into BAS systems if needed, but given the building layout, this seemed overkill and over cost. Individual local alarms can easily be added to showers, eyewash and hand held if needed. All

showers have floor drains. The Preventive Maintenance system will keep the trap seals by testing (keep the sewer gas out by keeping water in the trap).

4. The emergency shower/eyewash/drench fixtures do need good periodic testing, but other than that, it is a background system that does not require user intervention. False alarms will occur in the beginning.

F. Lab Gasses

1. There are two basics types of laboratory gas systems:
   a. Centralized bulk systems
      1. Clean dry compressed air
      2. Nitrogen
      3. Vacuum
   b. Specialty gas systems
2. Bulk systems are those in the order of 4-nines, as in the 4½-nines that can be expected to boil off from the leased LN2 tank. The vacuum system as described in this document is similarly plain vanilla, not a high vac system. The CA is very clean, not good enough for an FID, but a good input for a zero air generator and most common lab uses.
3. Bulk pressure systems (CA and N_2) are run in medical grade copper, cleaned, bagged and brazed with a nitrogen purge; i.e. like a hospital. The vacuum really does not need this purity level because it is an inherently dirty system.
4. Specialty gas systems are a notch up in quality from the bulk systems. This is very much analogous to the Type II RO loop being polished to Type I at the point of use of pure water (PW) units.
5. There are three specialty gas (SG) cylinder racks in the corridor layout. These cylinders are in three groups of five controllers along the lab corridor. Specialty gas is generally 5-nines and up and runs only in 316 SS.
6. There are three rotary screw central clean-air compressors in the CUP, described under the Mechanical systems. A sidestream is taken off of the system to feed additional polishing and pressure-adjusting equipment before becoming the Laboratory bulk compressed air (CA) systems shown on the P-series drawings.

6.4 Operations

A. The contractor shall provide and incorporate the following information into this Section for each system identified in this Volume.

1. Operations: The operating instructions shall include equipment and/or system layouts showing all piping, wiring, breakers, devices, controls, etc., complete with functional diagrams, schematics, isometrics, and data to explain the detailed operation and control of each individual piece of equipment and/or system, including system components. In addition to the above the following shall be incorporated:
2. Initial adjustments and control settings.
3. Precautions and pre-checks to be executed prior to startup of equipment and/or system, including safety devices, monitoring devices, and control sequence.
4. Step-by-step sequential procedures for startup and normal operation checks for satisfactory operation. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the operating instructions and fluffed for the attention of the operator. Procedures shall include test, normal, and automatic modes.
5. Procedures for normal and emergency shutdown of equipment and/or systems. The instructions shall include any procedures necessary for placing the equipment and/or system on standby or preparing the equipment and/or system for startup at a later time. Procedures shall include test, normal, and automatic modes.
6. Procedures for isolating individual equipment from the system and bringing individual equipment on line once the system is operating.
7. Operational logs and records requirements.

6.5 Preventive Maintenance

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Preventive Maintenance: Recommended procedures shall indicate PM (e.g., lubrication, checks, adjustments, etc.) and good-housekeeping practices which should be performed by operating personnel, as well as more complex maintenance procedures which would normally be performed only by trained maintenance personnel. The procedures shall be accompanied by a schedule indicating timeframes or operating hours for specific maintenance to be accomplished. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the maintenance procedures and flagged for the attention of personnel. The procedures shall include necessary operating instructions for taking equipment off-line, on-line, and putting equipment on standby. The instructions shall address all material, equipment, and system data needed to perform maintenance work and shall include, but not be limited to, manufacturers' bulletins, catalogs, and descriptive data; copies of approved test plans, including logs and

records of performance acceptance test results and actual adjustments made during final acceptance and inspection; system layouts, including block, wiring, control, and isometric diagrams; schematic items within the facility; and interrelationships with other items of the system.

2. Schedules indicating timeframes or operating hours for initiating operator maintenance and adjustments and including manufacturer's recommended major maintenance requirements shall be provided. Emergency adjustments shall be included and flagged for the operator's attention. The instructions shall also include procedures for emergency repairs that could be performed by operating personnel.

6.6 Trouble Analysis

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Trouble Analysis procedures for locating and correcting the trouble shall be presented in a step-by-step format. Repair procedures shall be keyed to a troubleshooting guide outlined in three columns with the following headings:

Trouble/Symptom	**Probable Cause(s)**	**Corrective Action**
The indication or symptom of trouble	The instructions, including test hookups, necessary to determine the cause(s)	Procedures for restoring the system to operating condition, or cross reference to where the procedure is written in MP&SOMM

2. The procedures shall clearly indicate a major repair activity, which should be performed only in a shop or factory, as opposed to normal repair work, which may be performed on-site or with equipment online. The procedures shall also clearly indicate the limit of repair work that may be performed by maintenance personnel during the warranty period without voiding warranty provisions. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the repair procedures and flagged for the attention of personnel.

6.7 Unscheduled/Corrective Maintenance

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Unscheduled/Corrective Maintenance and Checkout Procedures: Procedures for troubleshooting and isolation, replacement, checkout, and integration of equipment within the system shall be provided.
2. Trouble Analysis: Procedures for troubleshooting of malfunctions that might occur during operation of the system shall be provided. Troubleshooting data, and fault isolation techniques, shall state the following:
   a. The indication or symptom of trouble;
   b. The instructions, including test hookups, necessary to determine the cause; and
   c. Procedures for restoring the system to operating condition.
3. Troubleshooting shall be documented to the extent necessary to locate the faulty piece of equipment within the system. Information may be in chart form, in logic tree form, or in tabular format with appropriate headings.
4. Isolation, Replacement, Checkout, and Integration: Procedures for isolation, replacement, checkout, and integration of the equipment within the system shall be provided. Test, adjustment, and checkout data, after replacement, shall be included.

6.8 Repair Parts and Special Tools and Equipment

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Repair Parts List: A complete list of repair parts and supplies shall be provided. The list shall include all parts and components of individual pieces of equipment and all parts and components of each system and shall identify such items as nomenclature of part, model number, circuit of component identification, etc. Parts and supplies lists shall be included within each volume of maintenance instructions. Further, a master list of repair parts and supplies recommended from each manufacturer for one year of operation, including source of supply, shall be sub-listed with each instruction. The Contractor shall also list the sources of supply for all parts and supplies, including name of supplier/manufacturer, address, and telephone number. If the parts and supplies are not normally stocked locally, necessary procurement lead-time shall also be a part of the listing.
2. Special Tools and Test Equipment List: A list of all special tools and test, measurement, and diagnostic equipment required for system level maintenance shall be included. For the purposes of this specification, the phrase "special tools and test, measurement, and diagnostic equipment" is used to identify all nonstandard tools and equipment

designed and developed by the manufacturer and others to perform maintenance, test/calibration, diagnostic/prognostic analysis, and other related support of the equipment, as well as nonstandard tools required for installation, acceptance testing, and successful O&M. Frequency and method of calibration shall be indicated for all special tools, equipment and test equipment items that require calibration. Necessary standards shall be listed immediately after each item that requires calibration.

6.9 Vendor Data/Acceptance Tests

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Vendor Data: A complete set of data, provided by the equipment manufacturer, required for operation, maintenance and checkout shall be included and referenced to the appropriate specification number. Their data may consist of manufacturers' brochures, O&M manuals, catalogs, drawings, service bulletins, and illustrated parts lists necessary to support the O&M of the end item of equipment and assemblies.
2. A record of all Systems' Acceptance Tests shall be included in this section.

6.10 Warranty Information

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Warranty Information: In addition to the general warranty required and provided under the contract, the O&M manuals shall include any specific warranties required by other sections of the Technical Specifications and other warranties normally provided with the particular piece of equipment or system. Warranties that are normally provided by manufacturers and which are beyond the warranty for construction shall be specifically noted.

6.11 Design Master Equipment List

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. A completed master equipment list with guidance offered in Volume 1 - Comprehensive Management Plan. Exhibit MS-1 See information on the preparation of the Management Plan & Systems Operation and Maintenance Manual for further instructions on the preparation of this list.

2. Reference Exhibit P-1. All manufacturers' data on the operation and maintenance of the equipment.

6.12 Training Requirements

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. A training schedule in accordance with guidance offered in Volume 1 - Comprehensive Management Plan.
2. Reference Exhibit P-2 for guidance in the preparation of this schedule.

6.13 Exhibits

A. P-1 Design Master Equipment List

B. P-2 Training Schedule

C. P-3 (P601-P603) Plumbing Flow Diagram

D. P-5 (P701-P714) Plumbing Details

E. P-6 (P604) Plumbing Riser Diagrams

6.14 Exhibit P-1 Design Master Equipment List

SYSTEM INTERIOR WATER DISTRIBUTION								
SPECIFICATION PARAGRAPH NUMBER	TAG NUMBER	NOMENCLATURE	CHARACTERISTICS	DESIGN DRAWING NUMBER	ITEM MANUFACTURER	MODEL NUMBER	SERIAL OR PART NUMBER	LOCATION
15400	GWH-1	Domestic Water Heater	140 Gal/241 GPH Recover/ 200,000 BTUH	P-316				Room 923
15400	GWH-2	Domestic Water Heater	140 Gal/241 GPH Recover/ 200,000 BTUH	P-316				Room 923
15400	GWH-3	Protected Water Heater	140 Gal/387 GPH Recover/ 400,000 BTUH	P-316				Room 923
15400	GWH-4	ProtectedWater Heater	140 Gal/387 GPH Recover/ 400,000 BTUH	P-316				Room 923
15400	XTD1	Domestic Hw Expanison Tank	39 LITER	P-316				Room 923
15400	XLT1	Protected Hw Expanison Tank	76 LITER	P-316				Room 923
15405	LVAC	Laboratory Vacuum Set	28 scfm 2HP ea. Duplex	P-316				Room 923
15433	RODI	Pure Water System	5000 GPD Type II	P-316				Room 923
15433	MM	Multimedia Filter						
15433	WS	Water Softeners						
15433	CC	Carbon Adsorption						
15433	ROU-1	Reverse Osmosis Unit						
15433	ROU-2	Reverse Osmosis Humidification						
15433	CEDI	Electric Dionization						
15433	UV	Ultraviolet Sterilizer						
15433	ROT	RODI Storage Tank		P-500				
15400	ES-1	Emergency Safety Shower	30 GPM	P-				
15400	SMV	Safety MixingValve Sta	60 GPM at 85 deg F	P-				
15400	CW RPBP	Backflow Preventer CW	Duplexed Reduced Pressure	P-316				
15400	PCW RPB	Backflow Preventer PCW	Duplexed Reduced Pressure	P-316				
15400	NPW RPB	Backflow Preventer NPW	Duplexed Reduced Pressure	P-316				
15400	RO RPBP	Backflow Preventer RO	Duplexed Reduced Pressure	P-316				
15405	LWM-1	Lab waste Monitor	150 mm					BAS
15405	LWM-2	Lab waste Monitor	150 mm					BAS

Exhibit P-2 Training Schedule

TRAINING TIME BY EQUIPMENT & EQUIPMENT SYSTEMS	
NOMENCLATURE	**O/M Staff Training (Hours)**
Domestic Water Heater	1
Domestic Water Heater	1
Protected Water Heater	1
ProtectedWater Heater	1
Domestic Hw Expanison Tank	1
Protected Hw Expanison Tank	1
Laboratory Vacuum Set	2
Pure Water System	1
Multimedia Filter	1
Water Softeners	1
Carbon Adsorption	1
Reverse Osmosis Unit	1
Reverse Osmosis Humidification	1
Electric Dionization	1
Ultraviolet Sterilizer	1
RODI Storage Tank	1
Emergency Safety Shower	1
Safety MixingValve Sta	2
Backflow Preventer CW	1
Backflow Preventer PCW	1
Backflow Preventer NPW	1
Backflow Preventer RO	1
Lab waste Monitor	1
Lab waste Monitor	1
Total Hours	25

VOLUME

7

VOLUME 7 OPERATION AND MAINTENANCE REQUIREMENTS

Management Plan & Systems Operation and Maintenance Manual Templates Appendix A

Mechanical Systems

Table of Contents

7.1 General Information

A. The Management Plan & Systems Operation Maintenance Manual Templates are a part of the comprehensive program for operation and maintenance of the US Army Criminal Investigation Laboratory. For detailed information of how this section fits into the overall documentation of a comprehensive operation and maintenance program, reference the following related documents.

1. VOLUME 7 - Operation and Maintenance Statement of Work
2. Appendix A – Management Plan & Systems Operation and Maintenance Manual Templates
3. Drawings and Specifications
4. Equipment Manufacturer's Instructions

B. This volume is not intended to replace contract documents, shop drawings, as-built drawings, or equipment manufacturers' instructions. The intent is to supplement such documents and provide an overall format for organizing the information necessary to operate and maintain the system.

C. For guidance in completing this volume, reference O&M SOW Chapter 1 – 'Statement of Work' and Appendix A Volume 1 – 'Comprehensive Management Plan'.

D. The importance of the mechanical systems cannot be overstated. The mechanical system provides heating and cooling, ventilation, pressure and humidification, air handling and exhaust that shapes the environment inside the building.

E. The mechanical systems are always on line, and provide critical airflow to fume hoods, air interchanges, air quality and temperature control within the work space, and safety within the firing range. For this reason, the mechanical systems must be regularly inspected, tested, and maintained to ensure they are fully functional at all times.

F. This volume has been prepared for the maintenance personnel who will be responsible for the daily operation and maintenance of the plumbing systems installed in the USACIL. The purpose of this volume is to familiarize maintenance personnel with the operation and maintenance of the plumbing system at the USACIL, and to provide emergency and troubleshooting procedures.

7.2 Specific System Descriptions

A. HVAC Design Criteria

1. Outside Air Design Conditions

a. Due to the requirement for 100% outside air in laboratories using chemicals, use of standard comfort 2.5% and 97.5% outside air conditions is not recommended for design of laboratory HVAC systems. With high fractions of outdoor air, the capacity required to meet the space needs is directly related to a coil entering air condition that is approximately equal to the outdoor design condition. Variations above design will directly impact the systems ability to meet heating and cooling needs. In order to minimize the number of hours in a year when the system cannot fully meet these needs, the use of more conservative outside air criteria is recommended.

b. The outdoor air design conditions for this project is based on the 1% cooling dry-bulb/wet-bulb and 99% heating values

c. Air cooled equipment located behind the building was selected for an outside air temperature 2.5°C above the 1% design condition since equipment will be subject to radiant heating from adjacent equipment and on grade solar reflection.

2. Inside Design Conditions

a. Inside design conditions recommended are based on design directives that state that the design shall be in accordance with industry standards applicable to the highly specialized needs of a laboratory.

b. Based on review of ASHRAE Handbooks, inside design conditions have been adjusted from normal comfort conditions to account for the additional clothing (lab coats) worn by researchers within the lab. The 1991 ASHRAE Applications Handbook identifies the recommended inside design conditions for laboratories.

c. Recommended conditions are within the "comfort envelope" as defined in ASHRAE Standard 55 - 1992 Thermal Environmental Conditions for Human Occupancy.

3. Internal Loads and Ventilation Rates

a. Laboratories will use 100% outside air for ventilation as required by the USACIL Chemical Hygiene Plan (18 March 1998) and as recommended in ANSI/AIHA Standard Z9.5-1992. The values listed are in accordance with recommendations listed in OSHA, NFPA 45 and Prudent Practices.

b. Office and conference rooms will be provided with ventilation as required by ASHRAE Standard 62-1999 (1989 version with adopted addenda).

4. Primary Containment Devices (Fume Hoods and Biological Safety Cabinets)

a. Containment devices such as chemical fume hoods and biological safety cabinets will serve as the primary method of safety protection within the labs. General ventilation will be used only to prevent the buildup of fugitive emissions within the laboratory space.

5. Firing Range Criteria

a. Based on review of several National Institutes of Occupational Safety and Health studies, the following criteria were recommended for design of the firing range systems. NIOSH recommended criteria maintains a minimum velocity of 0.38 m/s across the firing line. This criteria was not acceptable to the USACIL safety officer and the design has been adjusted to reflect a minimum velocity of 0.5 m/s. The ceiling layout will be coordinated with the architect to minimize obstructions that can cause circulation of lead fumes into the breathing zone. The exhaust duct will be sized to maintain 17.8 m/s minimum velocity to prevent deposits of lead dust from accumulating. The exhaust will be filtered with 30% pre-filters and HEPA final filters to prevent discharge of lead dust onto surrounding roofs and landscape. Supply air will be provided at 21.1°C to 26.6°C as recommended by NIOSH. A double pegboard wall to provide even distribution across the sectional area of the range will also be specified.

b. Firing range ventilation system operation shall remain on when occupied per the USACIL Chemical Hygiene plan. During unoccupied periods the ventilation rate will be reduced while maintaining space temperatures.

6. Building Air Systems- General

a. The design intent of the HVAC air systems will be to create a containment module around the individual laboratory spaces. Pressure separations will be in the form of solid construction separation walls, entry vestibules and airflow differentials. Sealing of all penetrations of the enclosing walls will be specified. It is recommended that entry bio-vestibules be provided with door seals to enhance containment. The office and support spaces outside the laboratories will be maintained at a positive pressure in relation to the containment areas (labs) and the ambient (outdoor air) conditions. Evidence processing and selected areas in Trace Evidence will also be maintained positive within their respective lab zones. NOTE THAT ARSON PREP WILL BE MAINTAINED AT A NEGATIVE PRESSURE DUE TO THE USE OF A CHEMICAL FUME HOOD WITHIN THE SPACE. NFPA 45 REQUIRES LABS USING CHEMICALS TO REMAIN NEGATIVE. The entry bio-vestibules to the lab will remain negative with respect to the public and lab service corridor. This will prevent contaminants from escaping from the labs as required in NFPA 45 "Laboratories Using Chemicals". Positive pressure office spaces will also minimize overall building infiltration. Reducing infiltration of unconditioned outdoor air will assist in maintaining a comfortable environment in the perimeter spaces. In general, laboratory spaces will be maintained at a negative pressure by exhausting more air than is supplied. Space pressurization will proceed as follows; office spaces & circulation corridors - positive pressure, bio-vestibules - negative to offices and labs, labs – neutral air balance, lab corridor – positive to bio-vestibules. These pressure relationships will maintain containment around the laboratory section of the building, while maintaining separation between lab types.

b. Recommended minimum air change rates in the labs are defined in the appendix and are in general compliance with ANSI Standard #Z9.5 – 1992 and Prudent Practices in Laboratories Using Chemicals. For occupied periods, a minimum lab airflow rate of 6 air changes per hour will be used for design and analysis. During unoccupied hours, 4 air changes per hour is recommended as the minimum ventilation rate in accordance with NFPA 45. The analyses for this phase have been based on a variable air volume mechanical system that allows the flow to vary between the peak cooling load and the 6 air change per hour minimum flow rate established for design.

7. Supply Air Systems

a. The supply air for the project will be provided by air handling units/intakes located on the roof of the facility. This location will minimize the impact of site pollutant sources including emergency generators as well as local traffic. The intakes will be located as required to minimize the possibility of re-entrainment of exhaust air into the supply air system.

b. Load calculations indicate a required peak airflow of 79,000 L/s and a block load of 70,000 L/s. In accordance with ANSI #Z9.5 and NFPA Standard 45, the air serving the labs areas will be 100% outside air, exhausted through systems described below. The office/circulation areas have been provided with a dedicated supply and return air system to allow for re-circulation while maintaining segregation from the lab spaces. Outdoor air provided to the offices will also serve as makeup for the toilets and utility spaces. Toilets and utility spaces have also been provided with heating and cooling air in addition to makeup air. Systems will be provided with 30% pre-filters and 85% final filters.

c. Supply will be provided via pressure independent variable volume boxes. The selected VAV system requires each of the individual zones to also have a dedicated supply and exhaust air volume control box to allow tracking of the airflow since they will each vary with the internal load of the space. The air handling units will deliver cooling supply air to the boxes at 12.8 degrees C.

d. The air handling unit layout design is based on built-up curb mounted rooftop air handling units. The major benefit of built-up units over commercially available units is that the casings can be expanded to house the required supply VAV boxes. The extremely efficient floor plan layout does not have sufficient non-lab space to allow these boxes to be located in accessible locations within the building. In addition, locating the boxes within service corridors as part of the air-handling unit will allow for future changes in the required airflow of a lab without entering the investigator work areas.

e. Based on the above peak airflow, the building will require (6) air handlers each delivering approximately 14,000 L/s, capable of independent operation. Refer to the HVAC plans for additional information. No spare or redundant air handling units are included. Fan systems will be connected by a common header and will deliver air via VAV boxes located within the unit service corridors. Low- pressure ductwork will then be route to each heating and cooling zone. Since the units are headered, an 80% level of redundancy is provided without the additional cost of a spare air-handling unit. This capacity will meet the full needs of the lab during the majority of the year with the lab fully occupied (>80% of the year with lab fully occupied). With a relatively small occupancy or equipment use diversity, the redundancy will provide full capacity for even more of the year. HEPA filtration of supply air will be addressed via terminal units as needed.

f. The layout of the rooftop units provides required access areas and coil pull distances. Space required for maintenance and inspection is critical to providing proper service. Adequate maintenance is required to insure good indoor air quality as well as long equipment service life.

8. Exhaust Systems

a. The proposed exhaust fan layout is similar to the air handling unit layout design and has been based on built-up curb mounted housings. The major benefit of built-up housed fans over standard roof mounted fans is that the casings can be expanded to house the required exhaust VAV boxes. The extremely efficient floor plan layout does not have sufficient non-lab space to allow these boxes to be located in accessible locations within the building. In addition, locating the boxes within service corridors as part of the fan housing will allow for future changes in the required airflow of a lab without entering the investigator work areas.

b. The laboratory exhausts is manifolded together before discharge. The primary benefit of a manifold system is increased dilution. Individual zone exhaust will combine with other space exhaust within the exhaust fan unit housing. The exhaust will be then routed to main exhaust fans that will discharge through vertical (upblast) stacks. Goosenecks and rain caps are not recommended for use on laboratory exhaust systems. Discharge stacks will be provided as shown in the Industrial Ventilation guide as recommended by the American Conference of Industrial Hygienists. Discharge velocities from the stacks will be maintained above the 15.25 m/s recommended in ANSI/AIHA Standard #Z9.5. Exhaust stacks will be extended a minimum of 6.5m above the highest roof level. In order to match the lab loads, (5) - 14,000 L/s single width, single inlet centrifugal exhaust fans will be required. Refer to HVAC plans for additional information. No redundant fans have been included.

c. Specialty exhausts such as hazardous materials storage, radon mitigation systems (building dependent), perchloric acid or radioisotope hoods are not required and will need to be individually exhausted and filtered when required. Perchloric acid exhaust duct systems if required may also require a duct washdown system. Chemical storage cabinets will be exhausted as necessary. HEPA filtration of the exhaust will be addressed with terminal units where necessary.

1. Each lab module will be provided with at least one pressure-independent exhaust air volume control box. These devices will enable the operators to monitor the exhaust flow rate from each space and will allow alarm functions to be programmed into the building automation system based on actual measured flow rates. Where a single box cannot meet the capacity needs of a suite, a second box will be specified. In this application, the alarm function would be based on the total flow of the two boxes

2. General exhaust systems will include toilet exhaust, electric room exhaust as well as exhaust from copy rooms and other areas with potential for causing poor indoor air quality.

9. Space Heating Systems

a. The heating source will be provided from the facility central plant. A complete hot water system will be specified to supply hot water to the building reheat coils, cabinet heaters and unit heaters. The requirement for higher air change rates than standard high bay areas will allow effective heating with all air. The Building skin heat losses are relatively small compared to the heat required for the 100% outside air systems. Increased exterior glazing will be provided to allow as much natural light into the space as possible while still meeting the building envelope insulation limitations dictated by the applicable Energy Code and ASHRAE Standard 90.1.

b. The hot water system will be provided with variable flow pumping to minimize energy usage. A 15 degree C (30 degree F) system temperature drop is recommended to minimize pump flow rates.

10. Building Automation System (Controls)

a. The lab building will be specified with a direct digital control (DDC) and energy management system as identified in the specific instructions. The system, including all terminal controllers, will be compatible with, and capable of reporting all functions to a central building management system. The system shall be capable of controlling all functions (system and room control setpoints) from the "head end" computer. The system will also monitor and control the central plant equipment.

b. The central plant system will include monitoring and control functions for the chillers and boilers. BAS controls will include: optimum start/stop of the chillers/boilers and pumps, control loops for end of main bypasses, color graphic displays for the plant and building systems and display of real time pressure/temperature readings.

c. The laboratory control system will consist of DDC panels connected to a local area network (LAN). Control of terminal equipment and systems shall be through discrete microprocessor based DDC controllers. Controllers shall be linked through a twisted pair network. Each major piece of equipment will be provided with dedicated microprocessors capable of independent operation if disconnected from the network. All controllers and panels shall be connected to the standby power system.

d. Each mechanical system will be controlled by local DDC controllers. Air handler controls shall include unit start/stop, filter pressure drop alarms, constant supply air temperature control, building humidity control (monitored by space sensors), supply duct static pressure control via fan speed modulation, AHU staging, as well as all necessary safeties. The heating system shall include water outlet temperature control, pump start/stop, system differential pressure control via pump speed modulation and required safeties. The main exhaust fan systems shall control to maintain a constant duct static pressure (negative pressure) via fan speed modulation. Exhaust filters shall also be monitored and alarmed by the control system. The system shall monitor the system flow rate and stage fans on/off as required to maintain a constant discharge velocity above the 15.25 m/s design criteria listed above.

e. Local lab controls shall include space temperature control, occupied/unoccupied airflow control (VAV during occupied mode, if cost justified) and critical space pressure alarms with programmable delays. Each control zone shall be provided with a minimum of one supply and one exhaust air volume control box to allow for night setback of the flow. Local override of the BAS control functions will be provided in each lab.

f. Office spaces will be provided with a zoned temperature control system. Airflow will be modulated to a minimum ventilation position on a drop in space temperature (VAV system). Upon continued drop in temperature, a reheat coil valve will be modulated open. Minimum airflow setpoints will meet the requirements of both ASHRAE 62-89 (Ventilation) and 90.1-89 (Energy Conservation).

g. The Building Automation System shall perform the following functions and monitor/ control the following items.

1. Lab Freezer Alarms
2. Building Lighting
3. Monitor the Building Fire Alarm System
4. DI Water System Monitoring and Control
5. Local Steam Generators (if applicable)
6. Monitoring of normal power and of operation of the Emergency Generator
7. Air Compressors
8. Smoke Dampers
9. Optimized Start/Stop of all equipment
10. Graphic Display of each system
11. Real time display of all readings

h. Refer to the HVAC drawings for additional information.

11. Miscellaneous Systems

    a. Humidification at the main air handlers will be required in order to maintain the recommended minimum design condition of 35% + 5% relative humidity in the space. Since there is very limited need for steam in the building, a compressed air atomizing system was selected. The system will include oil free air compressors as the driving force to the distribution heads where it would be combined with a clean water source (system requires an RO source). The advantage of the atomizing system is the evaporative cooling effect that will reduce the peak cooling requirements on warm, dry days. This feature is also a penalty, since the preheat coils would need to be sized to offset this cooling effect in the colder months when the humidification system is most often required to operate. The energy penalty of the atomizing system has been included in the load analyses.

12. Mechanical & Electric Utility Space Systems

    a. The main electrical utility spaces will be tempered to manufacturers recommended temperatures via the main air handling system. Use of conditioned air is recommended to reduce the airflow rate required. All code required ventilation air supplied to spaces which house transformers will be exhausted to prevent smoke from being spread through the building in the event of an electrical fire. Recirculating units were not used since they would require chilled water to be available year round. The main system has been designed to include and air side economizer cycle and will not require the plant to operate during cold weather.

    b. Telephone data room may be cooled via the main air system to eliminate the need for year round chilled water and will likely require humidification. Humidification requirements will be dictated by the specified tele/data equipment. A chilled water type system is not recommended since it would require year round operation of the central plant

    c. Electric and telephone closets will be normally cooled with air transferred from the occupied spaces and 100% exhausted as discussed for the main electrical spaces. The main benefit of this system is that it will use the ventilation air provided to the offices as make-up and will not require an additional ducted makeup system.

    d. The mechanical spaces shall be provided with a thermostatically controlled ventilation system for summer operation and unit heaters for winter operation.

13. Fuel Oil Systems

    a. Because electricity is a critical utility required for this facility, a reliable power source must be maintained at all times. Standby power generation is therefore required. Planning for 48 full load hours of power generation is recommended in order to insure adequate fuel is provided.

    b. The electrical one line indicates required power generation including standby loads. In order for this standby electric system to function, fuel oil must be available when needed.

    c. Based on the generator system calculations, the volume of storage of fuel oil required can be provided with a tank mounted in the generator base.

14. Central Utility Plant

    a. The proposed operation and layout of the facility and the heating and cooling capacity required justify the use of a central utility plant. The plant was envisioned as a central utility space constructed as part of the laboratory building, cooling will be provided via packaged cooling units and fuel for heating of this facility is to be natural gas with propane/air mixture backup.

    b. Distribution of chilled water and hot water will be through steel piping systems.

15. Electric Air Cooled Chillers

    a. The proposed central cooling plant will consist of packaged electric air-cooled rotary compressor chillers that will provide chilled water to the new facility.

    b. The chiller plant will be designed so that four chillers will satisfy the maximum cooling load of the facility. Space has been allowed in the planning for the addition of a fifth chiller if needed for expansion of the laboratory. Each chiller will have a nominal capacity of 880 kW. The selection of (4) 880 kW chillers allows for 75% capacity with one chiller off line. This should provide adequate cooling for the entire facility except on design days where load shedding or diversity will be required to reduce cooling demand. Each chiller will be fed circulating water by a dedicated constant volume primary chilled water pump. The piping will be designed so that the pump valves can be manually set to serve an adjacent chiller in the event that a single pump fails. It is recommended that a minimum of three secondary chilled water pumps be used to serve the facility distribution system. The secondary pumps will be provided with variable frequency drives to minimize energy consumption.

c. Chilled water delta T of 6.7°C has been selected.

16. Gas Boilers

a. The proposed boiler plant for this facility will consist of (3) natural gas/propane air mixture hot water boilers. Space has been allowed in the planning for the addition of a fourth boiler if needed for expansion of the laboratory.

b. After review of the existing labs it was noted that there would be little need for process steam in the laboratory. It is therefore recommended that electric point of use generation be incorporated if needed. The boiler plant can then be designed to provide hot water directly to the preheat and reheat coils.

c. Two packaged 1470 kW and one 490 kW gas/propane fired boilers have been selected for the laboratory. The selection of boilers allows for approximately 65% of the required heating capacity plus 55% of the required humidification load with one boiler off line. Each boiler will be fed circulating water by a dedicated constant volume primary hot water pump. It is recommended that a minimum of three secondary hot water pumps be used to serve the facility distribution system. The secondary pumps will be provided with variable frequency drives to minimize energy consumption.

d. Safety controls will be included as required by code.

B. Energy Conservation Features

1. Energy Conservation Standards

a. The design of the systems will comply with the requirements of ASHRAE/IES Standard 90.1-1999 Energy Standard for Buildings Except Low-Rise Residential Buildings where possible. The unique requirements of laboratory spaces typically require a few modifications to maintain recommended design conditions.

b. Energy conservation items that will be incorporated into the design include (per ASHRAE 90.1-1999).

c. Equipment Efficiencies: Equipment has been specified to meet the requirements of the standard.

d. Air-Cooled Chillers – COP & IPLV = 2.8

e. Boilers – 80% Combustion Efficiency

f. Indoor design conditions, temperature & humidity shall be in accordance with ASHRAE Standard 55-1992.

g. Air leakage at doors and windows shall be limited to values listed in standard section 5.2.3.2.

h. Load calculations were performed in accordance with methods and requirements listed in ASHRAE Handbooks and design conditions listed above.

i. Water systems shall be designed for variable water flow (i.e. two way valves) and shall be capable of reducing flow to 50% of design rate or less.

j. Each heating and cooling zone shall be provided with individual thermostatic controls.

k. Heating control shall be capable of setback to 12.8°C. Cooling control shall be capable of setup to 32.2°C.

l. A minimum of 2.8°C deadband shall be provided for automatic changeover systems. Exceptions: Systems with special occupancy or usage, systems with manual changeover.

m. Systems shall have controls for automatic set back or shut down.

n. Supply and exhaust systems shall be provided with automatic or gravity dampers to automatically shutoff outdoor air.

o. Systems shall have means to control shut off or setback each heating & cooling zone except where zone schedules require all to shut down on the same schedule. Isolation areas shall not exceed 2300 square meters of conditioned space.

p. Each system shall have an airside or waterside economizer. System & economizer controls shall prevent an increase in system energy use during normal operation.

q. All HVAC system piping shall be insulated. Minimum thickness shall be as listed in the standard.

r. All HVAC supply and return ductwork and plenums shall be insulated. Minimum thickness shall be as listed in the standard.

s. Motors shall have minimum efficiency as defined in the standard and shall comply with the Energy Policy Act.

t. Ductwork shall be constructed in accordance with the 1995 SMACNA Duct Construction Standards.

u. Ductwork designed for pressures of 750 Pa or higher static pressure shall be leak tested.

v. Contractor shall provide maintenance manual to the owner.

w. Controls shall be commissioned (tested) to assure elements are calibrated, adjusted and in proper working condition.

2. Additional Energy Conservation Features

   a. In addition, state of the art energy conservation measures that will be incorporated in the design of the facility will include the following

   b. All HVAC equipment shall be monitored and controlled by a direct digital building and energy management system. The system will provide comprehensive operating control strategies for all pieces of equipment, as well as time of day scheduling.

7.3 Theory of Operation

A. Chilled Water System

1. The chilled water for the facility is generated via four (4) 880 kilowatt air cooled chillers (CH-1.1, CH-1.2, CH-1.3, and CH-1.4). When all four chillers are active they can prove the facility with 3520 kilowatts of cooling (1000 tons). The chilled water system has been designed with possible expansion in mind; the piping systems have been designed to accommodate a future 880 kilowatt chiller and associated primary pump.

2. The chilled water system is Direct Digital Controlled (DDC).

3. Each chiller is governed by its own integral control panel. This control panel is factory supplied and controls the chiller's central cooling/capacity logic, part load condition logic, and safety interlocks. One common chiller system control panel shall offer monitoring for all chillers and associated pumps. The Building Management System (BMS) shall determine when to stage chillers "on" and "off" depending upon the load requirements of the facility.

4. The BMS system shall rotate the lead position of the chiller on a weekly basis to equalize the run time for all four chillers.

5. Chiller Start Sequence

   a. Upon activation of a chiller start sequence the BMS shall perform the following tasks in the order shown:

      1. The chiller's water isolation valve(s) shall be commanded open. When the isolation valve(s) end switch(es) sense that the valves are no longer closed, a primary pump shall be enabled.. (Any primary pump may serve any chiller.)

      2. Chilled water flow shall be proved through the chiller's evaporator section via pressure differential sensors. Once flow has been established, and after a 30 second time delay, the chiller shall be enabled.

6. Primary Pump Control

   a. The primary pumps are constant volume devices that provide specific volume flow rate of water to the chiller(s) when chilled water is required within the facility.

   b. The quantity of primary pumps and chillers on at any time shall be determined by a combination of both flow and water temperature. Normally a minimum of one (1) chiller and primary pump shall be operational at all times (when there exists a need for chilled water).

   c. If the lead chiller has been operational for more than 60 minutes and supply water temperature at the secondary water pumps rises by more than 1°C for ten (10) minutes or longer, a lag chiller sequence shall be initiated.

   d. The lag chiller shall be cycled "on" as outlined above in "Chiller Start Sequence".

   e. If the lag chiller and lead chiller have been operational for more than 60 minutes and supply water temperature at the secondary water pumps rises by more than 1°C for ten (10) minutes or longer, a second lag chiller sequence shall be initiated. At this time 3 (three) chillers and primary pumps shall be energized.

   f. The above sequence shall also govern the enabling of the fourth chiller (3rd lag chiller) if required.

   g. The BMS system shall constantly monitor the total chilled water flow rate at the secondary chilled water pumps and the primary chilled water pumps. If the flow rate at the primary pumps is recorded as being greater (38 liters) than the flow at the secondary pumps for a time span of 15 minutes, the BMS system shall register this situation as a reason to stop one chiller and one primary pump.

   h. If the situation persists for 15 minutes after the fourth chiller is stopped, another chiller (and primary pump) shall be commanded to stop. This sequence shall also be used to stop the 3rd lag chiller if required.

   i. Shutdown of the lead chiller shall only be permitted by manual input from the operator.

7. Secondary Chilled Water Control

   a. The secondary chilled water pumps are devices that provide a varying flow rate of chilled water to the facility's central air handling units and other chilled water devices as required. A device called a variable frequency drive modulates building power to the pump motor which allows the pump to cycle between @ 30% and 95% of its rated capacity; on a moderately warm day the pump(s) would be running at a lower speed and on a very warm day the pump(s) would be running closer to their rated capacity to provide adequate cooling to the facility. All secondary pumps shall be "off" when the primary pumps and chillers are "off". The lead chilled water pump shall be rotated weekly to equalize run time.

b. The secondary pumps are governed by chilled water system pressure; if the governing pressure sensor requires additional system pressure to satisfy its setpoint, then the pumps shall be commanded to speed-up and if system pressure is higher than setpoint the pumps shall be slowed down. The system pressure is influenced by the opening and closing of chilled water valves that serve the facility's central air handling units and other chilled water devices. As valves open the system pressure tends to decrease because there is a demand for additional chilled water. As valves close the system pressure tends to go up because there is an overabundance of chilled water.

c. If the system pressure sensor causes the lead pump to speed up providing a flow rate that is greater than 80-percent of its rated capacity (for a time of 10 consecutive minutes) the BMS system shall command a lag pump to energize. The lag pump shall be started at low speed and shall ramp up until both VFD's are operating at approximately equal speeds. With two pumps running, the BMS shall modulate their individual VFD's in unison to maintain system pressure setpoint.

d. If the lead and lag pumps are caused to speed up providing a flow rate that is greater than 160-percent of their combined rated capacity (2 at 80-percent each), for a time of 10 consecutive minutes, the BMS system shall command the third pump (2nd lag pump) to energize. The lag pump shall be started at low speed and shall ramp up until all VFD's are operating at approximately equal speeds. With three pumps running, the BMS shall modulate their individual VFD's in unison to maintain system pressure setpoint.

e. If all three secondary chilled water pumps are running and their respective VFD's modulate their flow rates down to 135-percent of their total rated capacity (45-percent each) for 10 consecutive minutes the BMS system shall de-energize one of the lag pumps and the remaining VFD's shall modulate in unison.

f. If the flow rate of the two remaining pumps is modulated below 90-percent of their combined total capacity (45-percent each) for 10 consecutive minutes the BMS system shall de-energize the other lag pump and the remaining VFD's shall modulate to maintain system setpoint.

g. If the flow rate of the last pump (lead pump) drops below 35-percent of its rated capacity the low flow bypass valve shall modulate open enough to force the lead pump to provide 45-percent of its rated flow capacity.

h. The low flow bypass assembly is a strategy that is used to ensure that an absolute minimum chilled water flow rate is not reduced past a certain point.

8. Water Treatment/Protection

a. The chilled water system employs a variety of equipment which serve to protect the system's integrity.

b. An air separator is used to filter entrained air out of the chilled water system so that the air does not harm the moving parts of the system (e.g. pump impellers)

c. An expansion tank is used to allow the gradual increase in system water volume caused by fluctuations in its temperature.

d. A chemical shot feeder is used to manually introduce chemicals to the system water to make certain the water maintains an acceptable pH level.

e. Many strainers are used throughout the system to catch and filter debris from the water. These filters are manually cleaned throughout the year.

f. Heat Trace is used to protect piping that is exposed to outdoor freezing conditions.

9. Emergency Power

a. Upon a loss of building power all chiller plant devices shall return to their pre-determined failsafe positions. Once standby power is established, the BMS shall allow the system operator to manually start one of the chillers, if required. The chillers do not start automatically on standby power.

10. Hot Water System

a. The hot water for the facility is generated via three (3) natural gas/propane boilers. The boilers can produce a total of 3430 kilowatt of heat (B-1.1= 490 Kw, B-1.2 = 1470 Kw, and B-1.3 = 1470 Kw). The hot water system has been designed with possible expansion in mind; the piping system has been designed to accommodate a future boiler and associated primary pump.

b. After initial manual start-up the hot water system is Direct Digital Controlled (DDC).

c. Each boiler is governed by its own integral control panel. This control panel is factory supplied and controls the boiler's central heating/capacity logic, part load condition logic, and safety interlocks. One common boiler system control panel shall offer monitoring for all boilers and associated pumps. The Building Management System (BMS) shall determine when to stage boilers depending upon the load requirements of the facility.

d. Typically the lead and lag boilers shall run 24 hours a day, 7 days a week.

e. The BMS system shall rotate the lead position of the chiller on a weekly basis to equalize the run time for all four chillers.

11. Boiler Start Sequence

a. Upon activation of a boiler start sequence the BMS shall perform the following tasks in the order shown.

b. Upon signal to start a boiler, the BMS shall first energize the boiler room ventilation sequence. No boiler shall start until the combustion air dampers are open.

c. The boiler's water isolation valve(s) shall be commanded open. When the isolation valve(s) end switch(es) sense that the valves are no longer closed, the boiler's individual primary pump shall be enabled. One primary pump is dedicated for each boiler. Water flow must remain constant through the boilers. If water flow were for some reason to stop, but the boiler remained active, the water within the boiler shell would eventually flash into steam and rupture the boiler.

d. Hot water flow shall be proved through the boiler via pressure differential sensors. Once flow has been established, and after a 30 second time delay, the boiler shall be enabled.

12. The primary pumps are constant volume devices that provide specific volume flow rate of water to their respective boiler when hot water is required within the facility

13. The quantity of primary pumps and boilers on at any time shall be determined by a combination of both flow and water temperature. Normally a minimum of one (1) boiler and primary pump shall be operational at all times.

14. Each active boiler shall fire to maintain a leaving water temperature of 85°C.

15. Secondary Hot Water Control

a. The secondary hot water pumps are devices that provide a varying flow rate of hot water to the facility's central air handling units and other hot water devices as required. A device called a variable frequency drive modulates building power to the pump motor which allows the pump to cycle between @ 30% and 95% of its rated capacity. All secondary pumps shall be "off" when the primary pumps and boilers are "off". The lead hot water pump shall be rotated weekly to equalize run time.

b. The secondary pumps are governed by hot water system pressure; if the governing pressure sensor requires additional system pressure to satisfy its setpoint, then the pumps shall be commanded to speed-up and if system pressure is higher than setpoint the pumps shall be slowed down. The system pressure is influenced by the opening and closing of hot water control valves that serve the facility's central air handling units and other hot water devices. As valves open the system pressure tends to decrease because there is a demand for additional hot water. As valves close the system pressure tends to go up because there is an overabundance of hot water.

c. If the system pressure sensor causes the lead pump to speed up providing a flow rate that is greater than 80-percent of its rated capacity (for a time of 10 consecutive minutes) the BMS system shall command a lag pump to energize. The lag pump shall be started at low speed and shall ramp up until both VFD's are operating at approximately equal speeds. With two pumps running, the BMS shall modulate their individual VFD's in unison to maintain system pressure setpoint.

1) If the lead and lag pumps are caused to speed up providing a flow rate that is greater than 160-percent of their combined rated capacity (2 at 80-percent each), for a time of 10 consecutive minutes, the BMS system shall command the third pump (2nd lag pump) to energize. The lag pump shall be started at low speed and shall ramp up until all VFD's are operating at approximately equal speeds. With three pumps running, the BMS shall modulate their individual VFD's in unison to maintain system pressure setpoint.

d. If all three secondary chilled water pumps are running and their respective VFD's modulate their flow rates down to 135-percent of their total rated capacity (45-percent each) for 10 consecutive minutes the BMS system shall de-energize one of the lag pumps and the remaining VFD's shall modulate in unison.

e. If the flow rate of the two remaining pumps is modulated below 90-percent of their combined total capacity (45-percent each) for 10 consecutive minutes the BMS system shall de-energize the other lag pump and the remaining VFD's shall modulate to maintain system setpoint.

f. If the flow rate of the last pump (lead pump) drops below 35-percent of its rated capacity the low flow bypass valve shall modulate open enough to force the lead pump to provide 45-percent of its rated flow capacity.

g. The low flow bypass assembly is a strategy that is used to ensure that an absolute minimum water flow rate is not reduced past a certain point.

16. Water Treatment/Protection

a. The hot water system employs a variety of equipment which serve to protect the system's integrity.

b. An air separator is used to filter entrained air out of the hot water system so that the air does not harm the moving parts of the system (e.g. pump impellers).

c. Expansion tanks are used to allow the gradual increase in system water volume caused by fluctuations in its temperature.

d. A chemical shot feeder is used to manually introduce chemicals to the system water to make certain the water maintains an acceptable pH level.

e. Many strainers are used throughout the system to catch and filter debris from the water. These filters are manually cleaned throughout the year.

17. Standby Power

a. Upon a loss of building power all boiler plant devices shall return to their pre-determined failsafe positions. Once standby power is established, the BMS shall allow the system operator to manually start one of the boilers, if required. The boilers shall not start automatically on standby power.

18. Boiler Room Ventilation System

a. The boiler room ventilation system is a ductwork system that provides 100-percent outside air to the boiler room for the purposes of combustion. So long as the boilers are required to fire, they must be fed a specific amount of air to aid in the process of combustion of their fuel source. If the proper amount of combustion air is not supplied to the room the boilers shall not fire at their optimal capability.

b. Outside air is introduced to the boiler room through a ducted fan system that employs the use of air filters, a hot water coil to temper the air, and a hot water circulating pump. The hot water pump is enabled when the entering outside air of the system is below 2°C. The constant movement of water through the heating coil suppresses the possibility of water freezing in the coil. When the entering air is above 5°C, the pump is disabled.

19. Laboratory Air Handling Units

a. The conditioned air that is supplied to the laboratory areas is provided by 5 air handling units that are all located on the roof of the facility. Each of these AHU's provides 100-percent outside air at a rate of 14,160 liters/second. The total possible combine system flow rate is 70,800 liters/second.

b. Each of the laboratory AHU's is manifolded together through a system of ductwork. The idea behind this arraignment is, if one AHU is damaged or off-line, then its air distribution system can be supplied with air from any other unit at any time. The facility would then operate at a reduced supply air quantity for a period of time until the damaged unit could be repaired and restarted.

c. Each AHU houses terminal air boxes that serve lab spaces within the building. These terminal boxes are vertically mounted within the AHU and attached to a common supply air plenum. Once the supply air passes through the terminal boxes it is delivered to the lab space. After the supply air has mixed with the lab room air (providing ventilation and temperature conditioning) it is removed by a separate exhaust air system.

d. All AHU's are controlled via the DDC control system.

20. Air Handling Unit Operating Description

a. In order to ensure that directional airflow into labs using chemicals is maintained at all times, the AHU start-up shall not occur until flow in the laboratory exhaust air system is established. Once the exhaust air flow status has been confirmed, the AHU's shall be allowed to start. Normally the AHU's shall be operational 24 hours a day, 7 days a week.

b. Upon a signal to start (issued by the BMS) the air handling units' outside air damper(s) and isolation damper(s) shall modulate to their respective fully open positions. Once the dampers have been proved open, the AHU's associated supply air fan shall be enabled. The supply fan's respective variable frequency drive shall start the fan at low speed and gradually ramp the fan's speed up to maintain the desired airflow rate. Supply air flow rate is governed by the ductwork system pressure downstream of the terminal air boxes.

c. The outside air is filtered, humidified, and temperature conditioned by the AHU's integral components: two filter banks remove air particulate matter so that the air maintains a specific quality of cleanliness; hot water and chilled water coils are modulated to provide the proper temperature conditioning for the supply air; and a humidifier has been provided to produce the proper supply air relative humidity for the lab spaces.

21. Volume Control

    a. The AHU variable frequency drives shall be modulated by the BMS system in parallel to maintain supply duct system static pressure setpoint. The BMS shall adjust the speed of all operating VFD's until they are running at approximately the same speed.

    b. As the system requirements for air volume increase and system static pressure decreases, the VFD's shall speed up. As system requirements for air volume decrease (as sensed by an increase in system static pressure), the VFD's speed shall be reduced.

22. Air Temperature Control

    a. Temperature sensors placed downstream of the AHU's isolation damper(s) govern the control of discharge air temperature.

    b. The AHU's direct digital control system panel shall modulate the pre-heat coil and cooling coil control valves in sequence to maintain setpoint temperature. If the supply air temperature is at or above the setpoint of 10°C, the chilled water control valve shall be fully opened and the pre-heat valve shall be fully closed. As the supply air temperature drops, the chilled water control valve shall modulate closed as necessary to maintain temperature setpoint. As the supply air temperature continues to drop, the pre-heat coil control valve shall modulate open to maintain setpoint. Upon a rise in supply air temperature, the reverse situation shall occur.

    c. If the outside air temperature is sensed to be at or below 2°C, the hot water coil freeze protection pump shall energize. Upon a rise in outside air temperature at or above 5°C, the pump shall be disabled.

23. Humidity Control

    a. Relative humidity levels within the laboratory spaces shall be constantly monitored by the DDC system from multiple locations. The location sensor that registers the lowest relative humidity shall be the governing signal for humidification.

    b. Upon a call for humidification the BMS system shall first prove that the associated AHU supply fans are operational, then the unit humidifier control valve shall modulate open to provide water injection into the air stream. This is done to ensure that the water vapor is evaporated fully into the air stream and does not pool within the unit.

c. The supply air humidity level for each AHU shall be constantly monitored by and internal sensor. If the humidity level rises above 85-percent for 10 consecutive minutes, the humidifier control valve shall modulate closed.

24. Standby Power

a. Upon a loss of building power all air handling units and integral devices shall return to their pre-determined failsafe positions. Once standby power is established, the BMS shall automatically start one of the AHU's. Once normal power is restored, all AHU's shall be automatically re-started

25. Administrative Air Handling Unit

a. The conditioned air that is supplied to the administration area is provided by 1 air-handling unit that is located on the roof of the facility. The AHU provides @25-percent outside air at a rate of 14,760 liters/second (3,540 l/s outside air).

b. The administrative air-handling unit employs a dedicated system of supply air and return air ductwork to the building spaces it serves. The supply air system is comprised of variable air terminal boxes that modulate air flow to the administrative areas depending upon the cooling requirements at different times. These terminal boxes are remotely mounted from the air handling unit. Once the supply air passes through the terminal boxes it is delivered to the space. After the supply air has mixed with the lab room air (providing ventilation and temperature conditioning) it is removed by a separate exhaust air system.

c. The AHU is controlled via the DDC control system. The DDC shall perform timeclock functions to provide the following modes of operation: occupied and unoccupied.

26. Air Handling Unit Operating Description

a. To ensure that directional airflow into labs using chemicals is maintained at all times, the AHU start-up shall not occur until flow in the laboratory exhaust air system is established. Once the exhaust air flow status has been confirmed, the AHU's shall be allowed to start. Normally the AHU's shall be operational 24 hours a day, 7 days a week.

b. Upon a signal to start (issued by the BMS) the air handling unit's outside air damper, return air damper, and relief air damper, shall all modulate to maintain the minimum quantity of outside air for the space. The isolation air damper shall open fully. Once the dampers have been proved open, the AHU's associated supply air fan and return fan shall be enabled. Both the fans shall be controlled via their respective variable frequency drives. The drives shall start the fans at low speed and gradually ramp the fan's speed up to maintain the desired airflow rate. Supply airflow rate is governed by the ductwork system pressure downstream of the terminal air boxes.

c. The outside air is filtered and tempered by the AHU's integral components: filter banks, hot water coil, and chilled water coil.

27. Volume Control

a. The AHU variable frequency drives shall be modulated by the BMS system in parallel to maintain supply duct system static pressure setpoint. The BMS shall adjust the speed of all operating VFD's until they are running at approximately the same speed.

b. As the system requirements for air volume increase and system static pressure decreases, the VFD's shall speed up. As system requirements for air volume decrease (as sensed by an increase in system static pressure), the VFD's speed shall be reduced.

28. Air Temperature Control

a. A temperature sensor placed downstream of the AHU's isolation damper shall govern the control of discharge air temperature.

b. The AHU's direct digital control system panel shall modulate the heating coil and cooling coil control valves in sequence to maintain setpoint temperature. If the supply air temperature is at or above the setpoint , the chilled water control valve shall be fully opened and the pre-heat valve shall be fully closed. As the supply air temperature drops, the chilled water control valve shall modulate closed as necessary to maintain temperature setpoint. As the supply air temperature continues to drop, the pre-heat coil control valve shall modulate open to maintain setpoint. Upon a rise in supply air temperature, the reverse situation shall occur.

c. If the outside air temperature is sensed to be at or below the freeze-stat's setpoint an alarm shall be initiated at the BMS system. This shall also cause all the unit's fans to cycle "off" and for all the modulating valves to close. A manual reset button must be pushed for the unit to be returned to the control of the BMS system.

29. Economizer Control

a. Normally the DDC system shall compare the outside air temperature with the return air temperature through the use of temperature sensors. If the outside air is consistently higher than that of the return air stream the DDC system shall keep the AHU in the minimum outside air mode. When the return air temperature rises above the temperature of the outside air, the DDC system shall initiate economizer mode. Economizer mode shall cause the outside air damper(s) to open fully and for the relief air damper to also open fully. The unit's chilled water control valve shall modulate closed.

30. Laboratory Exhaust System

a. To ensure that the laboratories remain under the influence of negative air pressure (at all times), the exhaust fans shall be started prior to the supply air system (AHUs)

b. The exhaust air that is removed from the laboratories is moved by 5 exhaust air fans that are mounted within exhaust cabinet enclosures that are situated on the roof of the laboratory. Each of these exhaust houses are able to removed air from the labs at a rate of 14,160 liters/second. The total possible combine system flow rate is 70,800 liters/second.

c. Each laboratory exhaust house is manifolded together through a system of ductwork. The idea behind this arraignment is, if one exhaust house is damaged or off-line, then its air distribution system can be supplemented with air from any other unit at any time. The facility would then operate at a reduced exhaust air quantity for a period of time until the damaged unit could be repaired and restarted.

d. Each exhaust house contains exhaust air terminal air boxes that serve lab spaces within the building. These terminal boxes are vertically mounted within the housing and attached to a common exhaust air plenum. Once the exhaust air passes through the terminal boxes it is delivered to the exhaust fan, and then rejected to the atmosphere. Make-up air for the laboratories is provided by the supply air handling units discussed above.

31. Exhaust Unit Operating Description

a. To ensure that directional airflow out of the labs is maintained at all times, the AHU start-up shall not occur until flow in the laboratory exhaust air system is established. Once the exhaust air flow status has been confirmed, the AHU's shall be allowed to start. Normally the EF's shall be operational 24 hours a day, 7 days a week.

b. Upon a signal to start (issued by the BMS) the lead exhaust fan's isolation damper shall open fully. Once the damper has been proved to be fully open, the exhaust fan's associated variable frequency drive (VFD) shall be enabled by the BMS system. The fan shall start out at low speed and gradually be ramped up as required to achieve the desired exhaust airflow rate. Exhaust air flow rate is governed by the ductwork system pressure upstream of the exhaust terminal air boxes.

c. If with one fan operating and the exhaust air static pressure setpoint is not achieved, then successive fans shall be staged on to maintain air flow.

32. Starting Fans while Other Fans are Operating

a. Care must be taken while energizing an "offline" fan to supplement other fans that may be running. If not done carefully air flow control and space pressure control can be sacrificed.

b. When an offline fan is commanded (by the BMS system) to enable, the associated VFD shall be enabled and shall start the fan at low speed and shall increase the fan's speed until a specific pressure differential is recorded across the fan's isolation damper. This protocol is required to ensure that once the isolation damper opens air shall begin exhausting from the ductwork system.

c. Once the differential pressure is sensed for a time period of 30 seconds the isolation damper shall be opened. While the damper is modulating to its fully open position, the VFD shall modulate its associated fan in response to static pressure deviations. This fan control shall be isolated just to the fan being started. All other fans that were previously operating shall remain at constant speed. When the isolation damper has been proved open, the exhaust fan shall be controlled via the "volume control loop" discussed below.

d. Once all exhaust fans are active and after a pre0determined time delay, all fan speeds of all fan motors shall be adjusted by the BMS system until they are operating at the same speed. The fans shall then be modulated in unison to maintain ductwork static pressure control.

e. When a fan is taken off line by the BMS system, its isolation damper shall first begin to close, and once the damper is closed the fan's VFD shall be commanded off. The remaining fans that are running shall be modulated in unison to maintain ductwork static pressure.

33. Volume Control

a. The exhaust fans' VFD(s) shall modulate to maintain exhaust system static pressure setpoint as sensed by a pressure sensor that is mounted within the ductwork system.

b. All enabled exhaust fans shall be modulated to maintain a specific pressure difference that is relative to the exhaust fan's structural enclosure.

c. Typically as system requirements for air volume decrease the static pressure at the controlling sensor becomes higher due to surplus exhaust air flow rate. When this occurs, the exhaust fan VFD shall slow down. Conversely, as system requirements for air volume increase, the static pressure at the controlling sensor becomes lower due to the demand for exhaust air flow. When this occurs, the VFD shall speed up.

34. Fan Staging

a. Exhaust fans shall be staged “on” based upon measured air flow rates at specific locations within the exhaust system.

b. The BMS shall continuously monitor the flow rate of all fans operating. When any operating fan flow measures 60-percent of its design capacity, one of the operating fans shall be taken “off-line”.

c. Conversely when any operating fan flow measures 95-percent of its design capacity, an additional fan shall be enabled.

35. Standby Power

a. Upon a power failure, all devices shall go to their failsafe positions. When standby power becomes available, two exhaust fans shall be started and shall operate under normal control. When normal power is restored, all fans shall revert to their normal operating sequence. All fans shall re-start according to the fan sequence.

36. Laboratory Type #1 Sequence

a. Supply Air Control

1. During the occupied mode of the lab, the variable air volume boxes (VAV) shall control the supply air flow rate to the space to maintain space temperature and to provide adequate make-up air to all the fume hoods contained within the space. In some instances multiple VAV boxes are required to provide supply air to a particular space. When this situation exists, the BMS shall modulate the air dampers in parallel to maintain temperature setpoint.

2. When the space is occupied and the temperature sensor is satisfied the VAV boxes shall provide the maximum occupied flow rate that is required by the space. As the space temperature drops (as reported by the room thermostat) the VAV boxes shall modulate towards their respective minimum flow rate. If the space temperature continues to drop after the VAV boxes have reached their minimum pre-set flow rates, the VAV box reheat coil control valve(s) shall be modulated to maintain temperature setpoint within the lab space. Upon a reported rise in space temperature the reverse process shall occur.

3. During the scheduled “unoccupied” mode for the lab, the airflow shall be controlled based upon the sash position of the fume hood(s). If the fume hood(s) sash(es) is closed, the BMS system shall control the supply air flow from the VAV’s to provide fume hood make-up air.

4. As the space “occupied” mode is enabled the BMS system shall establish room exhaust air flow rate prior to modulating the supply VAV box(es) open.

b. Exhaust Air Control

1. The exhaust air terminal boxes (VVE) shall be two position, constant volume devices designed to provide exhaust air flow at only two quantities (maximum and minimum). The maximum exhaust air flow shall occur during the occupied mode and the minimum exhaust air flow shall occur during the unoccupied mode (when the fume hood sash is closed).

2. Some lab spaces employ the use of fume hood exhaust boxes and general room exhaust boxes. The latter type of exhaust air flow box shall be of a variable volume make, not a two position type device. The airflow setpoint for this type of box shall be the total supply air to the space plus the design flow differential, minus the fume hood exhaust air flow.

c. Standby Power

1. Upon the loss of normal power and the onset of standby power, all the exhaust air flow boxes shall operate as outlined above while the supply air boxes close to their unoccupied setpoint.

37. Laboratory Type #2 Sequence

a. Supply Air Control

1. During the occupied mode of the lab, the variable air volume boxes (VAV) shall control the supply air flow rate to the space to maintain space temperature and to provide adequate make-up air to all the fume hoods contained within the space. In some instances multiple VAV boxes are required to provide supply air to a particular space. When this situation exists, the BMS shall modulate the air dampers in parallel to maintain temperature setpoint.

2. When the space is occupied and the temperature sensor is satisfied the VAV boxes shall provide the maximum occupied flow rate that is required by the space. As the

space temperature drops (as reported by the room thermostat) the VAV boxes shall modulate towards their respective minimum flow rate. If the space temperature continues to drop after the VAV boxes have reached their minimum pre-set flow rates, the VAV box reheat coil control valve(s) shall be modulated to maintain temperature setpoint within the lab space. Upon a reported rise in space temperature the reverse process shall occur.

3. During the scheduled "unoccupied" mode for the lab, the supply airflow shall be reduced to the unoccupied flow rate scheduled.

4. As the space "occupied" mode is enabled the BMS system shall establish room exhaust air flow rate prior to modulating the supply VAV box(es) open.

b. Exhaust Air Control

1. Canopy hood exhaust air terminal boxes (VVE) shall be constant volume with their maximum flow occurring at all times.

2. The exhaust air terminal boxes (VVE) shall be two position, constant volume devices designed to provide exhaust air flow at only two quantities (maximum and minimum). The maximum exhaust air flow shall occur during the occupied mode and the minimum exhaust air flow shall occur during the unoccupied mode (when the fume hood sash is closed).

3. Some lab spaces employ the use of fume hood exhaust boxes and general room exhaust boxes. The latter type of exhaust air flow box shall be of a variable volume make, not a two position type device. The airflow setpoint for this type of box shall be the total supply air to the space plus the design flow differential, minus the fume hood exhaust air flow.

c. Standby Power

1. Upon the loss of normal power and the onset of standby power, all the exhaust air flow boxes shall operate as outlined above while the supply air boxes close to their unoccupied setpoint.

38. Laboratory Type #3 Sequence

a. Supply Air Control

1. During the occupied mode of the lab, the variable air volume boxes (VAV) shall control the supply air flow rate

to the space to maintain space temperature setpoint. In some instances multiple VAV boxes are required to provide supply air to a particular space. When this situation exists, the BMS shall modulate the air dampers in parallel to maintain temperature setpoint.

2. When the space is occupied and the temperature sensor is satisfied the VAV boxes shall provide the maximum occupied flow rate that is required by the space. As the space temperature drops (as reported by the room thermostat) the VAV boxes shall modulate towards their respective minimum flow rate. If the space temperature continues to drop after the VAV boxes have reached their minimum pre-set flow rates, the VAV box reheat coil control valve(s) shall be modulated to maintain temperature setpoint within the lab space. Upon a reported rise in space temperature the reverse process shall occur.

3. During the scheduled “unoccupied” mode for the space supply air flow provided by the box (or boxes) shall be reduced to the unoccupied flow setpoint.

4. As the space “occupied” mode is enabled the BMS system shall establish room exhaust air flow rate prior to modulating the supply VAV box(es) open.

b. Exhaust Air Control

1. The exhaust air terminal boxes (VVE) shall be variable air volume type devices. The exhaust box air flow rate(s) shall be equal to the supply air to the space plus the design flow differential, minus the fume extractor flow.

2. Some lab spaces employ the use of fume hood exhaust boxes and general room exhaust boxes. The latter type of exhaust air flow box shall be of a variable volume make, not a two position type device. The airflow setpoint for this type of box shall be the total supply air to the space plus the design flow differential, minus the fume hood exhaust air flow.

c. Standby Power

1. Upon the loss of normal power and the onset of standby power, all the exhaust air flow boxes shall operate as outlined above while the supply air boxes close to their unoccupied setpoint.

39. Laboratory Type #4 Sequence

a. Supply Air Control

1. During the occupied mode of the lab, the variable air volume boxes (VAV) shall control the supply air flow rate to the space to maintain space temperature. In some instances multiple VAV boxes are required to provide supply air to a particular space. When this situation exists, the BMS shall modulate the air dampers in parallel to maintain temperature setpoint.

2. When the space is occupied and the temperature sensor is satisfied the VAV boxes shall provide the maximum occupied flow rate that is required by the space. As the space temperature drops (as reported by the room thermostat) the VAV boxes shall modulate towards their respective minimum flow rate. If the space temperature continues to drop after the VAV boxes have reached their minimum pre-set flow rates, the VAV box reheat coil control valve(s) shall be modulated to maintain temperature setpoint within the lab space. Upon a reported rise in space temperature the reverse process shall occur.

3. During the scheduled "unoccupied" mode supply air flow provided by the box or boxes shall be reduced to the unoccupied flow setpoint. Unoccupied flow shall be maintained constant until occupied mode is initiated.

4. As the space "occupied" mode is enabled the BMS system shall establish room exhaust air flow rate prior to modulating the supply VAV box(es) open.

b. Exhaust Air Control

1. Canopy hood exhaust air terminal boxes (VVE) shall be constant volume with their maximum flow occurring at all times.

2. All bio-safety VVE boxes shall be constant volume type with their maximum flow occurring at all times.

3. In some instances multiple exhaust VAV boxes are required to provide exhaust air from a particular space. When this situation exists, the BMS shall modulate the air dampers in parallel to maintain exhaust air flow setpoint.

c. Standby Power

1. Upon the loss of normal power and the onset of standby power, all the exhaust air flow boxes shall operate as

outlined above while the supply air boxes close to their unoccupied setpoint.

40. Laboratory Type #5 Sequence

a. Supply Air Control

1. The lab space shall employ the use of variable air volume terminal box(es) that shall maintain a fixed airflow setpoint equal to the flow of the HEPA filtration bank that is connected to the supply air ductwork. The HEPA filter bank is used to filter very fine particles out of the air stream.

2. A wall mounted thermostat (mounted within the space) shall report air temperature to the BMS system. Upon a drop in space temperature (below a pre-determined setpoint) the BMS shall signal the VAV box's hot water control valve to modulate open to maintain setpoint. If the thermostat records a temperature above setpoint, the water valve shall be modulated closed.

b. Exhaust Air Control

1. The exhaust air terminal boxes (VVE) shall remove a quantity of air from the space that is equal to the supply air flow rate less the space differential that is shown on the plans.

2. Some lab spaces employ the use of multiple exhaust air boxes to remove air from the space. When multiple boxes are used within a single space, the BMS system shall modulate the VVE boxes in parallel to maintain the total zone flow setpoint.

c. Standby Power

1. Upon the loss of normal power and the onset of standby power, all the VAV and VVE boxes shall operate as indicated above to keep the space positively pressurized.

41. Laboratory Type #6 Sequence

a. Exhaust Air Control

1. Exhaust air shall be removed from the space via a dedicated exhaust air fan. This fan shall run 24 hours a day, seven days a week.

2. The exhaust fan shall be controlled via a wall mounted hand switch that shall be manually activated. When the hand switch is in the "on" position, the BMS shall

command the fan to start. When the hand switch is in the "off" position, the fan shall be de-energized.

42. Laboratory Type #7 Sequence

a. Supply Air Control

1. Variable air volume boxes shall maintain a constant supply air flow rate to the lab space to maintain the space temperature. When multiple VAV boxes are used within the space, the BMS shall modulate the boxes in unison to maintain the space temperature setpoint.

2. Upon a decrease in the space temperature (below the heating setpoint) the heating water control valve shall be modulated open to maintain space temperature. Upon a rise in space temperature, the reverse shall occur.

b. Standby Power

1. Upon the loss of normal power and the outset of standby power, the lab supply box(es) shall operate as shown above.

43. Laboratory Type #8 Sequence

a. Exhaust Air Control

1. Variable air volume exhaust boxes shall control to maintain a constant exhaust air flow rate from the fume extractors, slot exhausts, and vented cabinets (at all times).

2. During all time periods the exhaust devices shall maintain maximum exhaust flow.

b. Standby Power

1. Upon the loss of normal power and the outset of standby power, the lab exhaust box(es) shall operate as shown above.

44. Laboratory Type #9 Sequence

a. Firing Range

1. The environmental controls for the firing range shall be comprised of a dedicated exhaust air fan with a variable frequency drive, supply VAV boxes, and a dedicated DDC control panel.

2. The exhaust fan shall be enabled prior to allowing supply air from the VAV boxes to be introduced to the space. Once exhaust air flow is established, the supply VAV boxes shall open and maintain a minimum air flow setpoint.

3. During the unoccupied mode, the exhaust fan VFD shall slow down to a pre-determined minimum setpoint and the supply VAV boxes shall modulate down to a minimum setpoint.

4. Once the occupied mode is initiated the exhaust fan VFD shall speed up to maximum flow rate and the supply VAV boxes shall open to provide adequate make-up air to the space minus a pre-set differential. The hot water heating control valves shall modulate open to provide heating to the supply air stream should the space temperature drop below setpoint.

b. Tank Room

1. The supply and exhaust VAV boxes shall operate at their respective maximum flow rates 24 hours a day, 7 days a week to maintain pressurization relative to adjacent labs and firing range.

2. Space temperature shall be maintained as discussed above.

45. Utility Sequence

a. Supply Air Control

1. Variable air volume boxes shall maintain a constant supply air flow rate to the utility space to maintain the space temperature. When multiple VAV boxes are used within the space, the BMS shall modulate the boxes in unison to maintain the space temperature setpoint.

2. During all time periods, the supply box(es) shall maintain maximum flow rate.

3. Upon a decrease in the space temperature (below the heating setpoint) the heating water control valve shall be modulated open to maintain space temperature. Upon a rise in space temperature, the reverse shall occur.

b. Exhaust Air Control

1. The room air exhaust shall be constant via a dedicated fan. The fan shall run continuously and shall be controlled by the BMS system. The BMS shall command the fan’s isolation damper open and the fan to be enabled during the outset of the occupied cycle. The reverse shall occur at the outset of the unoccupied cycle.

c. Standby Power

1. Upon the loss of normal power and the outset of standby power, the space supply box(es) shall operate as shown above.

46. Training Room Sequence

a. Occupied Mode

1. Occupied mode for the Training rooms shall be initiated via a manual switch mounted upon each zone temperature sensor. The initiation of a single zone shall cause all training rooms to go into occupied mode.

2. Upon activation of the occupied cycle the supply VAV boxes shall open and control to maintain a constant supply air flow rate to the spaces and shall maintain space temperature setpoint. During the occupied cycle the supply boxes shall supply the maximum quantity of air that is required by the space. Upon a decrease in space temperature (below setpoint) the VAV box hot water valve shall modulate open to maintain space temperature. Upon an increase in space temperature, the water valve shall modulate closed.

3. Exhaust air shall be removed from the training space via one main fan that is directly tied into all training rooms and by several smaller exhaust fans that are individually associated with a single room. The main exhaust fan shall remove a nominal amount of air from all the spaces and the individual fans shall remove a balance of air that is equal to the supply air volume minus the main exhaust fan volume.

4. At the end of the occupied cycle the smaller individual fans shall be disabled.

b. Unoccupied Cycle

1. During the unoccupied cycle the supply VAV boxes shall maintain a constant supply air flow rate to the spaces and shall maintain space temperature setpoint.

2. The supply air VAV boxes shall supply a minimum quantity of air to the space. As space temperature drops the heating coil control valve shall modulate to maintain setpoint temperature.

3. The main exhaust fan shall remove air from the space while the smaller dedicated fans remain off line.

7.4 Operations

A. The contractor shall provide and incorporate the following information into this Section for each system identified in this Volume.

1. Operations: The operating instructions shall include equipment and/or system layouts showing all piping, wiring, breakers, devices, controls, etc., complete with functional diagrams, schematics, isometrics, and data to explain the detailed operation and control of each individual piece of equipment and/or system, including system components. In addition to the above the following shall be incorporated:
2. Initial adjustments and control settings.
3. Precautions and pre-checks to be executed prior to startup of equipment and/or system, including safety devices, monitoring devices, and control sequence.
4. Step-by-step sequential procedures for startup and normal operation checks for satisfactory operation. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the operating instructions and fluffed for the attention of the operator. Procedures shall include test, normal, and automatic modes.
5. Procedures for normal and emergency shutdown of equipment and/or systems. The instructions shall include any procedures necessary for placing the equipment and/or system on standby or preparing the equipment and/or system for startup at a later time. Procedures shall include test, normal, and automatic modes.
6. Procedures for isolating individual equipment from the system and bringing individual equipment on line once the system is operating.
7. Operational logs and records requirements.

7.5 Preventive Maintenance

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Preventive Maintenance: Recommended procedures shall indicate PM (e.g., lubrication, checks, adjustments, etc.) and good-housekeeping practices which should be performed by operating personnel, as well as more complex maintenance procedures which would normally be performed only by trained maintenance personnel. The procedures shall be accompanied by a schedule indicating timeframes or operating hours for specific maintenance to be accomplished. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the maintenance procedures and flagged for the attention of personnel. The procedures shall include necessary operating

instructions for taking equipment off-line, on-line, and putting equipment on standby. The instructions shall address all material, equipment, and system data needed to perform maintenance work and shall include, but not be limited to, manufacturers' bulletins, catalogs, and descriptive data; copies of approved test plans, including logs and records of performance acceptance test results and actual adjustments made during final acceptance and inspection; system layouts, including block, wiring, control, and isometric diagrams; schematic items within the facility; and interrelationships with other items of the system.

2. Schedules indicating timeframes or operating hours for initiating operator maintenance and adjustments and including manufacturer's recommended major maintenance requirements shall be provided. Emergency adjustments shall be included and flagged for the operator's attention. The instructions shall also include procedures for emergency repairs that could be performed by operating personnel.

7.6 Trouble Analysis

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Trouble Analysis procedures for locating and correcting the trouble shall be presented in a step-by-step format. Repair procedures shall be keyed to a troubleshooting guide outlined in three columns with the following headings:

Trouble/Symptom	**Probable Cause(s)**	**Corrective Action**
The indication or symptom of trouble	The instructions, including test hookups, necessary to determine the cause(s)	Procedures for restoring the system to operating condition, or cross reference to where the procedure is written in SOMM

2. The procedures shall clearly indicate a major repair activity, which should be performed only in a shop or factory, as opposed to normal repair work, which may be performed on-site or with equipment online. The procedures shall also clearly indicate the limit of repair work that may be performed by maintenance personnel during the warranty period without voiding warranty provisions. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the repair procedures and flagged for the attention of personnel.

7.7 Unscheduled/Corrective Maintenance

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Unscheduled/Corrective Maintenance and Checkout Procedures: Procedures for troubleshooting and isolation, replacement, checkout, and integration of equipment within the system shall be provided.
2. Trouble Analysis: Procedures for troubleshooting of malfunctions that might occur during operation of the system shall be provided. Troubleshooting data, and fault isolation techniques, shall state the following:
   a. The indication or symptom of trouble;
   b. The instructions, including test hookups, necessary to determine the cause; and
   c. Procedures for restoring the system to operating condition.
3. Troubleshooting shall be documented to the extent necessary to locate the faulty piece of equipment within the system. Information may be in chart form, in logic tree form, or in tabular format with appropriate headings.
4. Isolation, Replacement, Checkout, and Integration: Procedures for isolation, replacement, checkout, and integration of the equipment within the system shall be provided. Test, adjustment, and checkout data, after replacement, shall be included.

7.8 Repair Parts and Special Tools and Equipment

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Repair Parts List: A complete list of repair parts and supplies shall be provided. The list shall include all parts and components of individual pieces of equipment and all parts and components of each system and shall identify such items as nomenclature of part, model number, circuit of component identification, etc. Parts and supplies lists shall be included within each volume of maintenance instructions. Further, a master list of repair parts and supplies recommended from each manufacturer for one year of operation, including source of supply, shall be sub-listed with each instruction. The Contractor shall also list the sources of supply for all parts and supplies, including name of supplier/manufacturer, address, and telephone number. If the parts and supplies are not normally stocked locally, necessary procurement lead-time shall also be a part of the listing.

2. Special Tools and Test Equipment List: A list of all special tools and test, measurement, and diagnostic equipment required for system level maintenance shall be included. For the purposes of this specification, the phrase "special tools and test, measurement, and diagnostic equipment" is used to identify all nonstandard tools and equipment designed and developed by the manufacturer and others to perform maintenance, test/calibration, diagnostic/prognostic analysis, and other related support of the equipment, as well as nonstandard tools required for installation, acceptance testing, and successful O&M. Frequency and method of calibration shall be indicated for all special tools, equipment and test equipment items that require calibration. Necessary standards shall be listed immediately after each item that requires calibration.

7.9 Vendor Data/Acceptance Tests

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Vendor Data: A complete set of data, provided by the equipment manufacturer, required for operation, maintenance and checkout shall be included and referenced to the appropriate specification number. Their data may consist of manufacturers' brochures, O&M manuals, catalogs, drawings, service bulletins, and illustrated parts lists necessary to support the O&M of the end item of equipment and assemblies.
2. A record of all Systems' Acceptance Tests shall be included in this section.

7.10 Warranty Information

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Warranty Information: In addition to the general warranty required and provided under the contract, the O&M manuals shall include any specific warranties required by other sections of the Technical Specifications and other warranties normally provided with the particular piece of equipment or system. Warranties that are normally provided by manufacturers and which are beyond the warranty for construction shall be specifically noted.

7.11 Design Master Equipment List

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. A completed master equipment list with guidance offered in Volume 1 - Comprehensive Management Plan. Exhibit MS-1 See information on the preparation of the Management Plan & Systems Operation and Maintenance Manual for further instructions on the preparation of this list.
2. Reference Exhibit ME-1. All manufacturer's data on the operation and maintenance of the equipment.

7.12 Training Requirements

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. A training schedule in accordance with guidance offered in Volume 1 - Comprehensive Management Plan.
2. Reference Exhibit ME-2 for guidance in the preparation of this schedule.

7.13 Exhibits

A. ME-1 Design Master Equipment List

B. ME-2. Training Schedule

C. ME-3 (M601) HVAC Chilled Water Flow Diagram Mechanical Room

D. ME-4 (M602) HVAC Water Flow Diagram Mechanical Room

E. ME-5 (M603) HVAC Compressed Air Flow Diagram Mechanical Room

F. ME-6 (M604) HVAC Chilled Water Riser Diagram Lab

G. ME-7 (M605) HVAC Hot Water and Compressed Air Riser Diagram Lab

7.14 Exhibit ME-1 Design Master Equipment List

AIR HANDLING UNIT									
SPECIFICATION PARAGRAPH NUMBER	TAG NUMBER	NOMENCLATURE	CHARACTERISTICS						
			SUPPLY FAN			RETURN FAN		COOL TOTAL	HEAT TOTAL
			AIR FLOW	STATIC PRESSURE	NOM. MOTOR	AIR FLOW	NOM. MOTOR		
15895	AHU-1.1	LAB SUPPLY	14,160 L/s	1850 Pa	45 kW	-	-	767 kW	551 kW
15895	AHU-1.2	LAB SUPPLY	14,160 L/s	1850 Pa	45 kW	-	-	767 kW	551 kW
15895	AHU-1.3	LAB SUPPLY	14,160 L/s	1850 Pa	45 kW	-	-	767 kW	551 kW
15895	AHU-1.4	LAB SUPPLY	14,160 L/s	1850 Pa	45 kW	-	-	767 kW	551 kW
15895	AHU-1.5	LAB SUPPLY	14,160 L/s	1850 Pa	45 kW	-	-	767 kW	551 kW
15895	AHU-1.6	OFFICE SUPPLY	14,160 L/s	1600 Pa	40 kW	10,620 L/s	12 kW	400 kW	152 kW

PACKAGED AIR COMPRESSOR					
SPECIFICATION PARAGRAPH NUMBER	TAG NUMBER	NOMENCLATURE	CHARACTERISTICS		
			MAX PRESSURE	FREE AIR DELVERY	NOMINAL MOTOR
15211	ATTC-1.1	COMPRESSED AIR	860 kPa	140 L/s	60 KW
15211	ATTC-1.2	COMPRESSED AIR	860 kPa	140 L/s	60 KW

NATURAL GAS/PROPANE-AIR BOILER							
SPECIFICATION PARAGRAPH NUMBER	TAG NUMBER	NOMENCLATURE	CHARACTERISTICS				
			HEATING OUTPUT	EWT	LWT	FLOW	NOMINAL MOTOR
15569	B-1.1	HEATING NOT WATER	490 kW	65.5ºC	82.2ºC	7.0 L/s	1.5 kW
15569	B-1.2	HEATING NOT WATER	1470 kW	65.5ºC	82.2ºC	21.1 L/s	4.0 kW
15569	B-1.3	HEATING NOT WATER	1470kW	65.5ºC	82.2ºC	21.1 L/s	4.0 kW

AIR COOLED WATER CHILLER							
SPECIFICATION PARAGRAPH NUMBER	TAG NUMBER	NOMENCLATURE	CHARACTERISTICS				
			MIN COOLING	FLOW	EWT	LWT	MAX INPUT
15620	CH-1.1	CHILLED WATER	880 kW	31.5 L/s	12.6ºC	5.5ºC	533 MCA
15620	CH-1.2	CHILLED WATER	880 kW	31.5 L/s	12.6ºC	5.5ºC	533 MCA
15620	CH-1.3	CHILLED WATER	880 kW	31.5 L/s	12.6ºC	5.5ºC	533 MCA
15620	CH-1.4	CHILLED WATER	880 kW	31.5 L/s	12.6ºC	5.5ºC	533 MCA

AIR HANDLING UNIT							
SPECIFICATION PARAGRAPH NUMBER	TAG NUMBER	NOMENCLATURE	DESIGN DRAWING NUMBER	ITEM MANUFACTURER	MODEL NUMBER	SERIAL OR PART NUMBER	LOCATION
15895	AHU-1.1	LAB SUPPLY	M-302				ROOF
15895	AHU-1.2	LAB SUPPLY	M-303				ROOF
15895	AHU-1.3	LAB SUPPLY	M-303				ROOF
15895	AHU-1.4	LAB SUPPLY	M-304				ROOF
15895	AHU-1.5	LAB SUPPLY	M-304				ROOF
15895	AHU-1.6	OFFICE SUPPLY	M-303				ROOF

PACKAGED AIR COMPRESSOR							
SPECIFICATION PARAGRAPH NUMBER	TAG NUMBER	NOMENCLATURE	DESIGN DRAWING NUMBER	ITEM MANUFACTURER	MODEL NUMBER	SERIAL OR PART NUMBER	LOCATION
15211	ATTC-1.1	COMPRESSED AIR	M-216				MECH. ROOM
15211	ATTC-1.2	COMPRESSED AIR	M-216				MECH. ROOM

NATURAL GAS/PROPANE-AIR BOILER							
SPECIFICATION PARAGRAPH NUMBER	TAG NUMBER	NOMENCLATURE	DESIGN DRAWING NUMBER	ITEM MANUFACTURER	MODEL NUMBER	SERIAL OR PART NUMBER	LOCATION
15569	B-1.1	HEATING NOT WATER	M-216				MECH. ROOM
15569	B-1.2	HEATING NOT WATER	M-216				MECH. ROOM
15569	B-1.3	HEATING NOT WATER	M-216				MECH. ROOM

AIR COOLED WATER CHILLER							
SPECIFICATION PARAGRAPH NUMBER	TAG NUMBER	NOMENCLATURE	DESIGN DRAWING NUMBER	ITEM MANUFACTURER	MODEL NUMBER	SERIAL OR PART NUMBER	LOCATION
15620	CH-1.1	CHILLED WATER	M-217				YARD
15620	CH-1.2	CHILLED WATER	M-217				YARD
15620	CH-1.3	CHILLED WATER	M-217				YARD
15620	CH-1.4	CHILLED WATER	M-217				YARD

EXHAUST VARIABLE AIR VOLUME BOX			
SPECIFICATION PARAGRAPH NUMBER	TAG NUMBER	NOMENCLATURE	CHARACTERISTICS
			AIRFLOW
15895	VVE-1	-	0-190 L/s
15895	VVE-2	-	191-330 L/s
15895	VVE-3	-	331-520 L/s
15895	VVE-4	-	521-750 L/s
15895	VVE-5	-	751-990 L/s
15895	VVE-6	-	991-1320 L/s

FANS					
SPECIFICATION PARAGRAPH NUMBER	TAG NUMBER	NOMENCLATURE	CHARACTERISTICS		
			FLOWRATE	HEAD	NOM. MOTOR
15895	F-1.1	Lab Exhaust	14,160 L/s	1000 Pa	25 KW
15895	F-1.2	Lab Exhaust	14,160 L/s	1000 Pa	25 KW
15895	F-1.3	Lab Exhaust	14,160 L/s	1000 Pa	25 KW
15895	F-1.4	Lab Exhaust	14,160 L/s	1000 Pa	25 KW
15895	F-1.5	Lab Exhaust	14,160 L/s	1000 Pa	25 KW
15895	F-1.6	Toilet Exhaust	1040 L/s	500 Pa	1.2 KW
15895	F-1.7	Toilet Exhaust	590 L/s	275 Pa	0.4 KW

15895	F-1.8 thru 1.9	Mech. Room Supply	1760 L/s	325 Pa	1.2 KW
15895	F-1.10	Elec. Room Exhuast	1500 L/s	275 Pa	1.2 KW
15895	F-1.11	Firing Range Exhaust	3960 L/s	1550 Pa	12 KW
15895	F-1.12	Mech. Room Exhaust	920 L/s	250 Pa	0.6 KW
15895	F-1.13	Kit./Lounge Exhaust	810 L/s	500 Pa	0.75 KW
15895	F-1.14	Training Room Exhaust	765 L/s	350 Pa	0.6 KW
FANS Continued					
SPECIFICATION PARAGRAPH NUMBER	**TAG NUMBER**	**NOMENCLATURE**	**CHARACTERISTICS**		
15895	F-1.15	Training Room Exhaust	520 L/s	250 Pa	0.4 KW
15895	F-1.16	Training Room Exhaust	260 L/s	250 Pa	0.25 KW
15895	F-1.17	Evid. Proc. Exhaust	450 L/s	375 Pa	0.40 KW
15895	F-1.18	Elec. Room Exhaust	500 L/s	250 Pa	0.25 KW
15895	F-1.19	Elec. Room Exhaust	450 L/s	250 Pa	0.25 KW
15895	F-1.20	Imaging Toilet Exhaust	140 L/s	250 Pa	0.2 KW
15895	F-1.21	Training Room Exhaust	260 L/s	250 Pa	0.25 KW

ATOMIZING HUMIDIFIER				
SPECIFICATION PARAGRAPH NUMBER	**TAG NUMBER**	**NOMENCLATURE**	**CHARACTERISTICS**	
			CAPACITY	**COMPRESSED AIR FLOW**
15895	H-1.1	LAB AHU	76.5 g/s	0.56 L/s PER g/s
15895	H-1.2	LAB AHU	76.5 g/s	0.56 L/s PER g/s
15895	H-1.3	LAB AHU	76.5 g/s	0.56 L/s PER g/s
15895	H-1.4	LAB AHU	76.5 g/s	0.56 L/s PER g/s
15895	H-1.5	LAB AHU	76.5 g/s	0.56 L/s PER g/s
15895	H-1.6	OFFICE AHU	30.6 g/s	0.56 L/s PER g/s

SUPPLY VARIABLE AIR VOLUME BOX				
SPECIFICATION PARAGRAPH NUMBER	TAG NUMBER	NOMENCLATURE	CHARACTERISTICS	
			AIRFLOW	HEATING
15895	VV-1	-	0-190 L/s	5.1 kW
15895	VV-2	-	191-330 L/s	7.2kW
15895	VV-3	-	331-520 L/s	11.6 kW
15895	VV-4	-	521-750 L/s	16.0 kW
15895	VV-5	-	751-990 L/s	19.6 kW
15895	VV-6	-	991-1320 L/s	25.9 kW

EXHAUST VARIABLE AIR VOLUME BOX							
SPECIFICATION PARAGRAPH NUMBER	TAG NUMBER	NOMENCLATURE	DESIGN DRAWING NUMBER	ITEM MANUFACTURER	MODEL NUMBER	SERIAL OR PART NUMBER	LOCATION
15895	VVE-1	-	-				ALL AREAS
15895	VVE-2	-	-				ALL AREAS
15895	VVE-3	-	-				ALL AREAS
15895	VVE-4	-	-				ALL AREAS
15895	VVE-5	-	-				ALL AREAS
15895	VVE-6	-	-				ALL AREAS

FANS							
SPECIFICATION PARAGRAPH NUMBER	TAG NUMBER	NOMENCLATURE	DESIGN DRAWING NUMBER	ITEM MANUFACTURER	MODEL NUMBER	SERIAL OR PART NUMBER	LOCATION
15895	F-1.1	Lab Exhaust	M-307				Roof
15895	F-1.2	Lab Exhaust	M-306				Roof
15895	F-1.3	Lab Exhaust	M-306				Roof
15895	F-1.4	Lab Exhaust	M-305				Roof
15895	F-1.5	Lab Exhaust	M-305				Roof

FANS Continued							
SPECIFICATION PARAGRAPH NUMBER	**TAG NUMBER**	**NOMENCLATURE**	**DESIGN DRAWING NUMBER**	**ITEM MANUFACTURER**	**MODEL NUMBER**	**SERIAL OR PART NUMBER**	**LOCATION**
15895	F-1.6	Toilet Exhaust	M-301				Roof
15895	F-1.7	Toilet Exhaust	M-307				Roof
15895	F-1.8 thru 1.9	Mech. Room Supply	M-307				Roof
15895	F-1.10	Elec. Room Exhaust	M-307				Roof
15895	F-1.11	Firing Range Exhaust	M-202				Roof
15895	F-1.12	Mech. Room Exhaust	M-307				Roof
15895	F-1.13	Kit./Lounge Exhaust	M-301				Roof
15895	F-1.14	Training Room Exhaust	M-301				Roof
15895	F-1.15	Training Room Exhaust	M-301				Roof
15895	F-1.16	Training Room Exhaust	M-301				Roof
15895	F-1.17	Evid. Proc. Exhaust	M-214				Rm. 903
15895	F-1.18	Elec. Room Exhaust	M-302				Roof
15895	F-1.19	Elec. Room Exhaust	M-304				Roof
15895	F-1.20	Imaging Toilet Exhaust	M-305				Roof
15895	F-1.21	Training Room Exhaust	M-301				Roof

ATOMIZING HUMIDIFIER							
SPECIFICATION PARAGRAPH NUMBER	TAG NUMBER	NOMENCLATURE	DESIGN DRAWING NUMBER	ITEM MANUFACTURER	MODEL NUMBER	SERIAL OR PART NUMBER	LOCATION
15895	H-1.1	LAB AHU	-				ROOF
15895	H-1.2	LAB AHU	-				ROOF
15895	H-1.3	LAB AHU	-				ROOF
15895	H-1.4	LAB AHU	-				ROOF
15895	H-1.5	LAB AHU	-				ROOF
15895	H-1.6	OFFICE AHU	-				ROOF

SUPPLY VARIABLE AIR VOLUME BOX							
SPECIFICATION PARAGRAPH NUMBER	TAG NUMBER	NOMENCLATURE	DESIGN DRAWING NUMBER	ITEM MANUFACTURER	MODEL NUMBER	SERIAL OR PART NUMBER	LOCATION
15895	VV-1	-	-				ALL AREAS
15895	VV-2	-	-				ALL AREAS
15895	VV-3	-	-				ALL AREAS
15895	VV-4	-	-				ALL AREAS
15895	VV-5	-	-				ALL AREAS
15895	VV-6	-	-				ALL AREAS

SUPPLY VAV BOX W/O REHEAT			
SPECIFICATION PARAGRAPH NUMBER	TAG NUMBER	NOMENCLATURE	CHARACTERISTICS
			AIRFLOW
15895	VVS-1	-	0-190 L/s
15895	VVS-2	-	191-330 L/s
15895	VVS-3	-	331-520 L/s
15895	VVS-4	-	521-750 L/s
15895	VVS-5	-	751-990 L/s
15895	VVS-6	-	991-1320 L/s

PUMP					
SPECIFICATION PARAGRAPH NUMBER	TAG NUMBER	NOMENCLATURE	CHARACTERISTICS		
			FLOWRATE	HEAD	NOM. MOTOR
15569	P-1.1	PRIMARY HW	7.0 L/s	59.3 kPa	1.2 Kw
15569	P-1.2	PRIMARY HW	21.1 L/s	59.3 kPa	2.5 Kw
15569	P-1.3	PRIMARY HW	21.1 L/s	59.3 kPa	2.5 Kw
15569	P-1.4	SECONDARY HW	23.6 L/s	150 kPa	8 Kw
15569	P-1.5	SECONDARY HW	23.6 L/s	150 kPa	8 Kw
15569	P-1.6	SECONDARY HW	23.6 L/s	150 kPa	8 Kw
15569	P-1.7	FREEZE PROT	8.2 L/s	35.8 kPa	0.6 Kw
15569	P-1.8	FREEZE PROT	8.2 L/s	35.8 kPa	0.6 Kw
15569	P-1.9	FREEZE PROT	8.2 L/s	35.8 kPa	0.6 Kw
15569	P-1.10	FREEZE PROT	8.2 L/s	35.8 kPa	0.6 Kw
15569	P-1.11	FREEZE PROT	8.2 L/s	35.8 kPa	0.6 Kw
15569	P-1.12	FREEZE PROT	0.66 L/s	29.6 kPa	0.15 Kw
15569	P-1.13	FREEZE PROT	0.66 L/s	29.6 kPa	0.15Kw
15181	P-2.1	PRIMARY CHW	31.5 L/s	104.1 kPa	6 Kw
15181	P-2.2	PRIMARY CHW	31.5 L/s	104.1 kPa	6 Kw
15181	P-2.3	PRIMARY CHW	31.5 L/s	104.1 kPa	6 Kw
15181	P-2.4	PRIMARY CHW	31.5 L/s	104.1 kPa	6 Kw
15181	P-2.5	SECONDARY CHW	52.6 L/s	194.0 kPa	15 Kw
15181	P-2.6	SECONDARY CHW	52.6 L/s	194.0 kPa	15 Kw
15181	P-2.7	SECONDARY CHW	52.6 L/s	194.0 kPa	15 Kw

SUPPLY VAV BOX W/O REHEAT							
SPECIFICATION PARAGRAPH NUMBER	TAG NUMBER	NOMENCLATURE	DESIGN DRAWING NUMBER	ITEM MANUFACTURER	MODEL NUMBER	SERIAL OR PART NUMBER	LOCATION
15895	VVS-1	-	-				ALL AREAS
15895	VVS-2	-	-				ALL AREAS
15895	VVS-3	-	-				ALL AREAS

15895	VVS-4	-	-				ALL AREAS
15895	VVS-5	-	-				ALL AREAS
15895	VVS-6	-	-				ALL AREAS
PUMP							
SPECIFICATION PARAGRAPH NUMBER	**TAG NUMBER**	**NOMENCLATURE**	**DESIGN DRAWING NUMBER**	**ITEM MANUFACTURER**	**MODEL NUMBER**	**SERIAL OR PART NUMBER**	**LOCATION**
15569	P-1.1	PRIMARY HW	M-216				MECH. ROOM
15569	P-1.2	PRIMARY HW	M-216				MECH. ROOM
15569	P-1.3	PRIMARY HW	M-216				MECH. ROOM
15569	P-1.4	SECONDARY HW	M-216				MECH. ROOM
15569	P-1.5	SECONDARY HW	M-216				MECH. ROOM
15569	P-1.6	SECONDARY HW	M-216				MECH. ROOM
15569	P-1.7	FREEZE PROT	M-712				LAB AHU'S
15569	P-1.8	FREEZE PROT	M-712				LAB AHU'S
15569	P-1.9	FREEZE PROT	M-712				LAB AHU'S
15569	P-1.10	FREEZE PROT	M-712				LAB AHU'S
15569	P-1.11	FREEZE PROT	M-712				LAB AHU'S
15569	P-1.12	FREEZE PROT	M-216				CUP INTAKE
15569	P-1.13	FREEZE PROT	M-216				CUP INTAKE
15181	P-2.1	PRIMARY CHW	M-216				MECH. ROOM
15181	P-2.2	PRIMARY CHW	M-216				MECH. ROOM
15181	P-2.3	PRIMARY CHW	M-216				MECH. ROOM
15181	P-2.4	PRIMARY CHW	M-216				MECH. ROOM
15181	P-2.5	SECONDARY CHW	M-216				MECH. ROOM
15181	P-2.6	SECONDARY CHW	M-216				MECH. ROOM
15181	P-2.7	SECONDARY CHW	M-216				MECH. ROOM

7.15 Exhibit ME-2 Training Schedule

TRAINING TIME BY EQUIPMENT & EQUIPMENT SYSTEMS	
ATOMIZING HUMIDIFER	**O/M Staff Training**
Atomizing Humidifier	6 Hours
Control System	4 Hours
MISCELLANEOUS EQUIPMENT	**O/M Staff Training**
Fan Coils/Unit Heaters	8 Hours
HEPA Filters	4 Hours
BUILDING MANAGEMENT SYSTEM	**O/M Staff Training**
Building Management System	24 Hours
AIR COMPRESSOR SYSTEM	**O/M Staff Training**
Air Compressor and Associated System and Components	40 Hours
Building Management System	6 Hours
SUPPLY AIR SYSTEM	**O/M Staff Training**
Fans (Supply and Return)	8 Hours
Variable Air Volume Boxes (Supply)	8 Hours
Laboratory Air Handling Units	40 Hours
HEPA Filters	4 Hours
Building Management System	24 Hours
EXHAUST AIR SYSTEM	**O/M Staff Training**
Fans (Exhaust)	8 Hours
Laboratory Exhaust Units	32 Hours
Variable Air Volume Boxes (Exhaust)	8 Hours
Building Management System	16 Hours
HOT WATER DISTRIBUTION SYSTEM	**O/M Staff Training**
Water Pumps	24 Hours
Boilers	6 Hours
Water Valves	6 Hours
Water Coils (Heating)	4 Hours
Expansion Tank	4 Hours
Air Separator	4 Hours
Chemical Water Treatment	4 Hours
Building Management System	24 Hours
CHILLED WATER DISTRIBUTION SYSTEM	**O/M Staff Training**
Air Cooled Chiller	32 Hours
Chilled Water Pumps	6 Hours
Water Valves	6 Hours
Water Coils (Cooling)	4 Hours
Air Separator	4 Hours
Chemical Water Treatment	4 Hours
Building Management System	24 Hours

VOLUME

8

Management Plan & Systems Operation and Maintenance Manual Templates Appendix A

Electrical Systems

Table of Contents

8.1 General Information

A. The Management Plan & Systems Operation Maintenance Manual Templates are a part of the comprehensive program for operation and maintenance of the US Army Criminal Investigation Laboratory. For detailed information of how this section fits into the overall documentation of a comprehensive operation and maintenance program, reference the following related documents.

1. VOLUME 7 - Operation and Maintenance Requirements
2. Appendix A – Management Plan & Systems Operation and Maintenance Manual Templates
3. Drawings and Specifications
4. Equipment Manufacturer's Instructions

B. This volume is not intended to replace contract documents, shop drawings, as-built drawings, or equipment manufacturers' instructions. The intent is to supplement such documents and provide an overall format for organizing the information necessary to operate and maintain the system.

C. For guidance in completing this volume, reference VOLUME 4 Volume 1 – Statement of Work and Appendix A Chapter 1 – Comprehensive Management Plan.

D. The importance of the electrical systems cannot be overstated. The electrical systems provides power distribution for lighting, plumbing, HVAC, lab equipment, Building Automation System, and numerous other functions, lightning control systems, and emergency power for critical operations during interruptions of electrical service.

E. The electrical system, constantly in service, is the motive power for most of the other building systems and equipment. For this reason, the electrical systems must be regularly inspected, tested, and maintained to ensure they are fully functional at all times.

F. This volume has been prepared for the maintenance personnel who will be responsible for the daily operation and maintenance of the electrical systems installed in the USACIL. The purpose of this volume is to familiarize maintenance personnel with the operation and maintenance of the electrical system at the USACIL, and to provide emergency and troubleshooting procedures.

8.2 Specific System Descriptions

A. Utility Coordination and Site Considerations

1. Georgia Power Interface

a. The existing facilities are fed from a single-ended approximately 22 MVa substation transformer located in Georgia Power Company's substation. The substation is fed from an aerial 115 kV feeder which steps the voltage down to 12.47 kV for site distribution. A total of four 12.47 volt breakers located on the secondary side of the substation feed the Fort Gillem site.

2. Site Primary Power Distribution

a. Existing site primary power distribution is overhead and consists of a combination of #4/0 copper and #336 aluminum primary cable conductors.

b. New primary conductors from the overhead line load break switches will be ethylene propylene rubber (EPR) 133% insulated 15 kV class copper conductors, not exceeding 500 KCMIL in size.

c. Conduits containing medium voltage cable will be polyvinyl chloride (PVC) conduits encased in concrete, from an existing sectioniler primary switch at the intersection of N. 34th Street and N. S. Street.

3. Fiber Optic Site Distribution

a. Duct banks will be provided to the laboratory main data communications room from the existing communication vault at the intersection of N. 34th Street and N. S. Street.

B. Power Distribution

1. Normal House Power Distribution

a. Normal house power will be distributed from a double ended switchboard with a common tie breaker system located in the main electrical room.

b. There will be one outdoor pad mounted 3000/3360KVA transformers serving the indoor single-ended switchboard rated at 4000 amperes, 277/480V, 3 phase, 4-wire. Empty conduits will be provided for a future second padmount transformer which would allow for a double-ended configured system.

c. Normal power will be distributed throughout the building at 480 volts three-phase, three-wire for all motor loads and 480/277 volts, three-phase four-wire for lighting loads. General power is 208/120 volts three-phase, four-wire obtained by local standard, dry type transformers.

d. House power receptacles will be provided in corridors on 15 m centers with the end receptacles located less than 7.5 m from the ends of the corridor.

e. One duplex power receptacles will be provided at each office work station location, with a maximum of four duplex receptacles connected to a common circuit.

2. Electronic Equipment Power Distribution

a. Power for select electronic equipment will be distributed throughout the building at 480 volts three-phase, three-wire to dedicated local dry-type transformers. Conditioned power for these loads is provided by electrostatic shielded isolation transformers in the electrical closets. Transformers will have a minimum K-factor of 13 and be rated 480 volts delta primary - 208/120 volts wire, secondary, three-phase, four-wire.

b. Electronic equipment panelboards will be provided with an Isolated ground bus. These panelboards will also be provided with a 200 percent rated neutral bus for four wire applications. Feeders associated with these panelboards will be provided with a 200% rated neutral to handle any harmonic currents caused by the electronic loads. Individual branch circuits will be provided with a single neutral conductor for each single phase circuit. Common neutrals for multiple single phase circuits will not be provided.

c. One duplex receptacle will be provided at each office work station location with a maximum of two duplex receptacles connected to a common circuit.

3. Uninterruptible Power System

a. Critical power will be provided by a central uninterruptible power supply system (UPS). Individual rooms will be provided for the UPS and battery.

b. The central UPS is sized to provide 20 minutes of uninterruptible power to the following loads:

1. HVAC equipment required for life safety
2. Building automation system
3. Telecommunications switch
4. Data network equipment
5. 25% spare capacity

4. Laboratory Power

a. Laboratory power will be distributed throughout the building at 480 Volts, 3-phase, 3-wire distribution feeders to step down transformers in each electric closet. Laboratory utilization voltage will be 208/120 volts, 3-phase, 4-wire obtained by local standard, dry-type transformers. Laboratory distribution panels will be located in the electric closets respectively. Individual lab panels will be located within the lab areas. Laboratory panel feeders will be installed in conduits above ceilings or embedded in the concrete floor slab as deemed applicable, between the panel and associated distribution panel.

b. A maximum of four duplex receptacles will be connected to a common circuit. Alternating circuiting of adjacent duplex receptacles will be provided.

c. Dual compartment surface mounted raceways will be located at all wall and peninsula benches with receptacles mounted on 600mm centers. The second compartment will enable data requirements.

d. Ground fault protection will be provided for all receptacles within 900 mm of sink edges.

5. Emergency Power Distribution

a. Emergency and Stand-by power is provided via a new outdoor stand-alone packaged diesel fueled generator as follows:

kVA Rating	kW Rating	RPM	Voltage
1875	1500	1800	480-3 phase, 4 wire

b. The generator system will provide both emergency and standby power. Emergency power will be provided to the following loads via a four pole automatic closed transition transfer switch and an independent power distribution system within the building

1. Egress and Exit Lighting
2. Fire Alarm System
3. Generator Auxiliaries
4. Power and Lighting for Security Control Center

c. Stand-by power will be provided to the building via a four pole automatic closed transition transfer switch and an independent power distribution system. Stand-by power will be sized to provide 100% capacity to the Building 17 demand load plus 25% spare capacity. Included in this building load are the loads listed below as examples:

1. Telephone Switch
2. Security System

3. Mechanical Control System
4. Exhaust Fans for Life Safety
5. Uninterruptible Power Systems
6. Air Conditioning serving Rooms with Data Network Equipment
7. Laboratory supply and exhaust systems to maintain relative negative pressure of labs, exhaust from vented BSC, fume hoods and vented base cabinets under the hood.
8. Biological safety cabinets
9. Fume hood air flow monitor/audible-visual alarm
10. Dedicated exhaust from radio-chemical fume hoods
11. Environmental Rooms
12. Alarm system for freezers, incubators, liquid nitrogen (LN_2) and carbon dioxide (CO_2).

6. HVAC and Plumbing Equipment Power Distribution

a. HVAC and Plumbing equipment will be powered from motor control centers located in the Mechanical Room. Motor circuit protectors will be used for motor circuits of less than 37 kW and thermal-magnetic circuit breakers will be used for circuits of 37 kW and above.

b. Variable frequency drives shall be provided on large motors as deemed necessary from operations.

7. Equipment Sizing

a. The electrical equipment is sized to accommodate electrical loads as indicated in the load calculations included in the electrical load calculation report, found under separate cover.

b. To provide flexibility for future system changes, the electrical system is sized for 20% spare capacity for branch circuit panelboards, 25% spare capacity for distribution panelboards, and 25% spare capacity for main switchgear. Panelboards and equipment which directly serve HVAC equipment will be provided with 25% spare capacity.

c. Lighting panelboards are provided with 5 percent spare circuit breakers (minimum 3-20/1), plus 20 percent space (minimum 6 poles) for future circuits. Receptacle panelboards will be provided with 10 percent spare circuit breakers (minimum 6-20/1), plus 15 percent space (minimum 6 poles) for future circuits. Receptacle panelboards will be provided with feed-through lugs to facilitate future addition of circuits.

8. Pad Mounted Transformers

   a. Silicone-filled less flammable liquid insulated pad-mounted transformers rated 12.47 kV delta primary to 480/277 V wye secondary, with kVA ratings as indicated on the one line diagram. Transformers are specified to obtain 12% overload ratings. Transformers are sized for 100% redundancy. Each transformer will not be loaded more than 50% of its rating (Note: The 100% redundancy and 50% loading will occur when the 2nd transformer is installed).

   b. Secondary switchgear includes draw-out power circuit breakers with secondary mains and a tie breaker. Mains and tie breakers will be electrically operated with an automatic transfer scheme.

   c. Ground fault protection on secondary mains, ties and branch feeder breakers with zoned tripping will be provided as required by the NEC.

   d. Electronic metering will be provided on all mains and feeder breakers.

9. Electric Closets

   a. Remote Electric closets located on the floor plans, electric panels as follows and as shown on the one line diagram.

      1. 480/277v, three-phase, four-wire lighting panel

      2. 208/120v, three-phase, four-wire distribution panel (via step-down transformer).

      3. 480/277v, three-phase, four-wire emergency lighting panel.

   b. Lighting and receptacles located within the electrical closets are served by emergency power

C. Lighting

1. Exterior Lighting

   a. Lighting and receptacles located within the electrical closets are served by emergency power.

      1. General parking lot lighting is provided by Solar Powered pole mounted compact fluorescent fixtures. Fixtures are provided to give a maintained lux illuminant value of 5% with a 10 to 1 maximum to minimum ratio and a 4 to 1 average to minimum ratio.

b. Walkway Lighting

1. General walkway lighting is provided by bollard type fixtures. Fixtures are provided to give a maintained lux illuminant value of 5 with a 10 to 1 maximum to minimum ratio and a 4 to 1 average to minimum ratio.

c. Entrance Lighting

1. Wall mounted fixture will be located above all exit doors, except for the main entrance were fixtures are selected to coordinate with architectural treatment.

d. Mechanical and Electrical Switchyard Area Lighting

1. Wall mounted and pad mounted fixtures will be located to illuminate the electrical and mechanical switchyard. In addition fixtures will be provided above the doors to generator enclosures to provide a maintained lux illuminant value of 200.

2. Interior Lighting

a. General Information

1. Most interior lighting (i.e., offices) will be direct recessed parabolic louvered fluorescent type fixtures. Laboratories will generally be pendant mounted direct/indirect fluorescent type fixtures. Fixtures will have electronic ballasts and octron lamps for maximum efficiency, and energy conservation. Fluorescent ballast will be specified with consideration of the effects of harmonics on sensitive laboratory equipment.

2. Vapor-proof fixtures are provided in all areas of high humidity and or dampness.

3. Incandescent Lighting will be limited to areas only as defined by architectural accent, and in dark rooms.

4. High intensity discharge type fixtures will be used in high bay applications.

5. All fluorescent lighting will be wired to a 277 volt source unless otherwise indicated.

3. Illumination level

a. Illumination levels will be maintained as follows based on the I.E.S. handbooks:

Area/Function	Lux Level		Area/Function	Lux Level
Laboratory	500		Rest Rooms	215
Office Space	500		Tel/Data Closets	540
Conference Rooms	320		File/Record Storage	200
Lobby	160		Print Room	300
Mail Room	750		Storage Rooms, Janitors, closets	50
Security Stations	500		UPS Rooms	160
Mechanical Spaces	160		Elevator Machine Rooms	160
Electrical Spaces	160		Trash Room	200
Corridors	200			

b. Task lighting will be provided above fixed laboratory bench work to provide 900 LUX of illumination.

D. Emergency Lighting

1. Emergency/night lighting will be provided by means of fluorescent fixtures wired to the emergency life safety system. Emergency fixtures are unswitched in all common spaces. Where switching occurs an override relay will be provided.

E. Exit Lighting

1. Egress routes will be indicated with internally illuminated, LED exit signs.

F. Lighting Controls

1. Lighting control will be achieved via low voltage lighting control relay panels, which are located adjacent to respective lighting panels in the electric closets to interface with the Building Automation System. The lighting control relay panels include but are not limited to the following:

   a. Total system control from single location (i.e. main security desk).

   b. Telephone system control.

2. Local control will be provided as follows:

   a. Occupancy sensors for all private offices

   b. Daylight sensors to control/dim all perimeter lighting adjacent to windows.

   c. Daylight sensors to control main entrance lighting.

   d. Manual line voltage switching for mechanical type spaces.

G. Lightning Protection

1. A lightning protection system will be provided independent of nearby or adjacent structures.
2. The system will include copper coursing cables interconnecting air terminals on the roof and any metallic objects within 1830 mm of cable. Air terminals and cable spacing will be as per UL 96A for Class II systems.
3. Down leads will be installed in raceways and terminate at the ground ring encircling the building.
4. All materials used will be copper.
5. System will be required to meet all UL standards and require contractor to issue a Master Label at conclusion of installation.
6. Air terminal mounting types will be coordinated with area and material that the terminal will be mounted.
7. Incoming power and communication lines will be protected by appropriate surge protection equipment.

H. Grounding

1. A building ground system will be provided by means of a bare copper ground conductor installed around the entire perimeter of the building. The ground conductor will be installed approximately 760 mm from the building foundation wall and 1 m below grade.
2. Ground rods 20 mm x 3m copper clad will be provided at all corners to minimize ground resistance.
3. All building components and equipment requiring ground connections will be connected to the encircling ground ring. Equipment that will be connected includes the following.
   a. Standby/Emergency switchboards
   b. Electric room, telephone room and other selective room ground busses.
   c. Main telephone communications equipment.
   d. Main data communications equipment.
   e. Building steel.
   f. Building water service and all piping system.
   g. UPS System distribution equipment.
   h. All other devices and/or equipment as required by the National Electrical Code (NEC).

i. The following equipment will be connected to independent ground systems.

1. Pad Mount Transformer

2. Generator frames

j. A separate green insulated equipment grounding conductor will be included in all feeders and branch circuit raceways sized in accordance with the NEC.

k. A wall mounted, 6 mm by 50 mm copper ground bus will be provided in each electrical room. The ground bus will be located in the rear access aisle of the room and extend 1 m beyond the ends of the associate equipment. The ground bus will be interconnected with the building ground electrode and the ground bus within the electrical equipment.

l. A wall mounted 6mm by 50mm by 1000 mm ground bus will be provided in each electric closet, telecommunications closet and data closets. The ground bus will be interconnected with the building ground system.

m. A low frequency power system ground and a high frequency signal reference grounding system will be provided in the MDF portion of the facility.

n. The low frequency grounding system will provided throughout the facility to establish a single point grounding system in accordance with article 250 of the NEC. The single point ground will ground transformers and associated main service distribution panels.

o. The high frequency signal reference ground in the MDF portion of the facility will be made up of 600 mm squares. The grid will be made up of 1.3 mm by 50 mm copper strips laid on the structural floor. Data network equipment will be connected to the grid by the use of braided copper straps.

p. Grounding conductors for MDF, data network equipment will have grounding conductors equal in size to the phase conductors. Isolation transformers associated with power distribution units will be grounded to the grounding electrode in accordance with article 250 of the NEC, if required

I. Telephone and Data Communications Pathways

1. Work Stations

a. Provisions for Telephone and Data Communications in enclosed laboratories, offices, conference, electric, mechanical and similar rooms and spaces will include a wall box with a 26 mm conduit sleeve to the nearest Tel/Data closet or cable tray.

b. Work station conduit sleeves will be installed to cable trays located above the perimeter office corridors. Cable trays will be double rail ladder type trays. Cable trays will have a minimum bend of 1112mm.

2. Horizontal Pathways

a. A cable tray raceway system will be provided between the IDF (total of four) and MDF Rooms. This raceway will consist of a 450mm wide cable tray. Entrance into the IDF and MDF Rooms will be through three 100mm rigid steel conduits from the cable tray and penetrating at least 150mm into each MDF or IDF. All sleeves will be fire stopped. Sleeves not used will be capped to maintain fire rating.

3. Intermediate Distribution Facility

a. Four Intermediate Distribution Facilities will be provided for segregated voice and data services. IDF closets are sized and located in accordance EIA/TIA-569, Commercial building standard for telecommunications pathways and spaces.

b. The intermediate distribution facilities will consist of four individual closets with two located on each end of the floor for telecommunications and data interconnections with station wiring.

4. Main Distribution Facility

a. The main distribution facility will be located inside the computer room for switching and terminations of incoming telephone and data. The MDF will be sized and located in accordance with EIA/TIA-569, Commercial building standard for telecommunications pathways and spaces.

b. All main distribution facilities will be served from the central Uninterruptible power supply system.

J. Public Address System

1. The Public Address System consists of an audio distribution network which includes amplifiers, mixers, speakers, cabling and other ancillary components. Speakers, amplifiers and components are distributed throughout the facility to provide sufficient power and sound distribution in all indoor areas. The public address system is divided and serves ten individual zones as follows:

a. Zone 1. Front Office Area

b. Zone 2. Fire Arms and Tools

c. Zone 3. Serology

d. Zone 4. Trace Evidence

e. Zone 5. Questioned Documents

f. Zone 6. Conference Training Area

g. Zone 7. Latent Print

h. Zone 8. Imaging

i. Zone 9. Evidence Processing

j. Zone 10. Employee Lounge

2. The system is a unidirectional paging system and will be operated entirely through the normal office telephone system. The system will have the ability to page each zone individually or page all zones simultaneously.

8.3 Theory of Operation

A. Primary Power System

1. Primary power is supplied from a single Georgia Power 12.47 kV line. This line is terminated at the 15 kV fused disconnect located at the 3000/3360 kVa outdoor pad mounted transformer. This Delta-Wye connected transformer steps down the voltage from 12.47 kV to 480/277 Volts for distribution within the facility.

2. The secondary cables (at 480 Volts) are routed underground to the main 4000 Amp, 480/277 Volt switchboard located in the central electrical room.

3. Although the main switchboard is set up as a double ended arrangement, it is presently operated as single ended, supplying power to both switchboard busses through one main breaker with the bus tie breaker closed.

4. The main and bus tie breakers are electrically operated drawout type with remote control capabilities using a 125 VDC control source. The main breaker is furnished with a solid state direct acting trip device with long time delay and short time delay elements.

5. The bus tie breaker does not have an overcurrent trip device but is provided with a 125 VDC shunt trip. The main and bus tie breakers have a local control switch which is operable only when the breaker is in the connected or test position.

6. Feeder breakers are manually operated drawout type with solid state direct acting trip devices. The trip devices are equipped with long time delay and short time delay as well as instantaneous and ground trip elements.

7. The main switchboard (SWBD-1) also has a manually operated 2000 Amp feeder breaker for connection to a 1500 kVa temporary generator (refer to dwg. E-801). This breaker is key interlocked with the main supply breaker to prevent them from both being crossed at the same time.

B. Secondary Power System (Normal Power)

1. The 480/277 Volt normal power from the transformer is distributed throughout the facility beginning with the main switchboard (SWBD-1 & SWBD-2).

2. Normal power switchboards/panels (prefixed NP) are in most cases connected to the main switchboard in a radial fashion. In some instances directly connected, other instances directly connected through transformers, and in other instances subfed off other normal panels or switchboards.

3. The main switchboard also provides the normal 480/277 Volt power source to the automatic transfer switches (ATS) for more critical loads.

C. Emergency/Standby Power System

1. Emergency/standby power is supplied by an outdoor 1500 kW emergency generator. The standby power is distributed throughout the facility from the emergency/standby switchboard (EPHQW-SB) located in the main electrical room. This switchboard provides the standby power source to the automatic transfer switches (ATS) for the more critical loads.

2. Emergency (life safety) power is also supplied from the generator through a dedicated breaker connected directly to the emergency generator ahead of the standby switchboard (EPHQW-SB). This breaker, along with the generator, provides the emergency 480/277 Volt power source for ATS-1 and the life safety emergency loads via switchboard EPHW-LS (located in the Emergency Electrical Room 930) (refer to dwgs. E-803, 807 & 814). Several 480/277 Volt life safety panels, including EPHLNLS, EPHLELS and EPHLSLS, are located throughout the facility to service local life safety loads.

D. UPS Power Panels

1. UPS power panels are located throughout the facility and are supplied with 120/208 Volt power from the main UPS panel UPS-1 located in Electrical Room 929A

8.4 Operations

A. The contractor shall provide and incorporate the following information into this Section for each system identified in this Volume.

1. Operations: The operating instructions shall include equipment and/or system layouts showing all piping, wiring, breakers, devices, controls, etc., complete with functional diagrams, schematics, isometrics, and data to explain the detailed operation and control of each individual piece of equipment and/or system, including system components. In addition to the above the following shall be incorporated:

2. Initial adjustments and control settings.
3. Precautions and pre-checks to be executed prior to startup of equipment and/or system, including safety devices, monitoring devices, and control sequence.
4. Step-by-step sequential procedures for startup and normal operation checks for satisfactory operation. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the operating instructions and fluffed for the attention of the operator. Procedures shall include test, normal, and automatic modes.
5. Procedures for normal and emergency shutdown of equipment and/or systems. The instructions shall include any procedures necessary for placing the equipment and/or system on standby or preparing the equipment and/or system for startup at a later time. Procedures shall include test, normal, and automatic modes.
6. Procedures for isolating individual equipment from the system and bringing individual equipment on line once the system is operating.
7. Operational logs and records requirements.

8.5 Preventive Maintenance

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Preventive Maintenance: Recommended procedures shall indicate PM (e.g., lubrication, checks, adjustments, etc.) and good-housekeeping practices which should be performed by operating personnel, as well as more complex maintenance procedures which would normally be performed only by trained maintenance personnel. The procedures shall be accompanied by a schedule indicating timeframes or operating hours for specific maintenance to be accomplished. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the maintenance procedures and flagged for the attention of personnel. The procedures shall include necessary operating instructions for taking equipment off-line, on-line, and putting equipment on standby. The instructions shall address all material, equipment, and system data needed to perform maintenance work and shall include, but not be limited to, manufacturers' bulletins, catalogs, and descriptive data; copies of approved test plans, including logs and records of performance acceptance test results and actual adjustments made during final acceptance and inspection; system layouts, including block, wiring, control, and isometric diagrams; schematic items within the facility; and interrelationships with other items of the system.
2. Schedules indicating timeframes or operating hours for initiating operator maintenance and adjustments and including manufacturer's recommended

major maintenance requirements shall be provided. Emergency adjustments shall be included and flagged for the operator's attention. The instructions shall also include procedures for emergency repairs that could be performed by operating personnel.

8.6 Trouble Analysis

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Trouble Analysis procedures for locating and correcting the trouble shall be presented in a step-by-step format. Repair procedures shall be keyed to a troubleshooting guide outlined in three columns with the following headings:

Trouble/Symptom	**Probable Cause(s)**	**Corrective Action**
The indication or symptom of trouble	The instructions, including test hookups, necessary to determine the cause(s)	Procedures for restoring the system to operating condition, or cross reference to where the procedure is written in SOMM

2. The procedures shall clearly indicate a major repair activity, which should be performed only in a shop or factory, as opposed to normal repair work, which may be performed on-site or with equipment online. The procedures shall also clearly indicate the limit of repair work that may be performed by maintenance personnel during the warranty period without voiding warranty provisions. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the repair procedures and flagged for the attention of personnel.

8.7 Unscheduled/Corrective Maintenance

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Unscheduled/Corrective Maintenance and Checkout Procedures: Procedures for troubleshooting and isolation, replacement, checkout, and integration of equipment within the system shall be provided.

2. Trouble Analysis: Procedures for troubleshooting of malfunctions that might occur during operation of the system shall be provided. Troubleshooting data, and fault isolation techniques, shall state the following:

   a. The indication or symptom of trouble;

b. The instructions, including test hookups, necessary to determine the cause; and

c. Procedures for restoring the system to operating condition.

3. Troubleshooting shall be documented to the extent necessary to locate the faulty piece of equipment within the system. Information may be in chart form, in logic tree form, or in tabular format with appropriate headings.

4. Isolation, Replacement, Checkout, and Integration: Procedures for isolation, replacement, checkout, and integration of the equipment within the system shall be provided. Test, adjustment, and checkout data, after replacement, shall be included.

8.8 Repair Parts and Special Tools and Equipment

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Repair Parts List: A complete list of repair parts and supplies shall be provided. The list shall include all parts and components of individual pieces of equipment and all parts and components of each system and shall identify such items as nomenclature of part, model number, circuit of component identification, etc. Parts and supplies lists shall be included within each volume of maintenance instructions. Further, a master list of repair parts and supplies recommended from each manufacturer for one year of operation, including source of supply, shall be sub-listed with each instruction. The Contractor shall also list the sources of supply for all parts and supplies, including name of supplier/manufacturer, address, and telephone number. If the parts and supplies are not normally stocked locally, necessary procurement lead-time shall also be a part of the listing.

2. Special Tools and Test Equipment List: A list of all special tools and test, measurement, and diagnostic equipment required for system level maintenance shall be included. For the purposes of this specification, the phrase "special tools and test, measurement, and diagnostic equipment" is used to identify all nonstandard tools and equipment designed and developed by the manufacturer and others to perform maintenance, test/calibration, diagnostic/prognostic analysis, and other related support of the equipment, as well as nonstandard tools required for installation, acceptance testing, and successful O&M. Frequency and method of calibration shall be indicated for all special tools, equipment and test equipment items that require calibration. Necessary standards shall be listed immediately after each item that requires calibration.

8.9 Vendor Data/Acceptance Tests

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Vendor Data: A complete set of data, provided by the equipment manufacturer, required for operation, maintenance and checkout shall be included and referenced to the appropriate specification number. Their data may consist of manufacturers' brochures, O&M manuals, catalogs, drawings, service bulletins, and illustrated parts lists necessary to support the O&M of the end item of equipment and assemblies.
2. A record of all Systems' Acceptance Tests shall be included in this section.

8.10 Warranty Information

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Warranty Information: In addition to the general warranty required and provided under the contract, the O&M manuals shall include any specific warranties required by other sections of the Technical Specifications and other warranties normally provided with the particular piece of equipment or system. Warranties that are normally provided by manufacturers and which are beyond the warranty for construction shall be specifically noted.

8.11 Design Master Equipment List

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. A completed master equipment list with guidance offered in Volume 1 - Comprehensive Management Plan. Exhibit MS-1 See information on the preparation of the Management Plan & Systems Operation and Maintenance Manual for further instructions on the preparation of this list.
2. Reference Exhibit E-1. All manufacturer's data on the operation and maintenance of the equipment.

8.12 Training Requirements

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. A training schedule in accordance with guidance offered in Volume 1 - Comprehensive Management Plan.
2. Reference Exhibit E-2 for guidance in the preparation of this schedule.

8.13 Exhibits

1. E-1 Design Master Equipment List
2. E-2 Training Schedule

3. E-3 Electrical One-Line Diagram Sht. 1
4. E-4 Electrical One-Line Diagram Sht. 2
5. E-5 Electrical Emergency Standby Power One-Line
6. E-6 Electrical Standby Distribution Board One-Line
7. E-7 Electrical Motor Control Center "MCC-1", Sht. 1 of 3
8. E-8 Electrical Motor Control Center "MCC-1", Sht. 2 of 3
9. E-9 Electrical Motor Control Center "MCC-1", Sht. 3 of 3
10. E-10 Electrical ATS Switches 1 Through 5 One-Line
11. E-11 Electrical ATS Switches 6 Through 6 One-Line
12. E-12 Electrical Panel "NPLQS-1" One-Line
13. E-13 Electrical Panel "NPLQE-1" One-Line
14. E-14 Electrical Panel "NPLQN-1" One-Line
15. E-15 Electrical Panel "NPLQW2" One-Line
16. E-16 Electrical Panel "EPHMW-LS" One-Line
17. E-17 Electrical Panel "UPS-1" One-Line

8.14 Exhibit E-1 Design Master Equipment List

ELECTRICAL DISTRIBUTION SYSTEM

SPECIFICATION PARAGRAPH NUMBER	TAG NUMBER	NOMENCLATURE	CHARACTERISTICS	DESIGN DRAWING NUMBER	ITEM MANUFACTURER	MODEL NUMBER	SERIAL OR PART NUMBER	LOCATION
16415	NPLPN-1	Panelboard	208/120V. 225A. 3ph	E-901				Corridor 604
16415	NPLPN-2	Panelboard	208/120V. 225A. 3ph	E-902				Instr Lab 504
16415	NPLPN-3	Panelboard	208/120V. 400A. 3ph	E-902				Instr Lab 504
16415	NPLPN-4	Panelboard	208/120V. 225A. 3ph	E-903				L.P. Exam 704
16415	NPLPN-5	Panelboard	208/120V. 225A. 3ph	E-904				App Dev 710
16415	NPLPN-6	Panelboard	208/120V. 225A. 3ph	E-904				Latent Print 700
16415	NPLPN-7	Panelboard	208/120V. 225A. 3ph	E-905				Drug Chief 501
16415	NPLPN-8	Panelboard	208/120V. 225A. 3ph	E-905				Tech Sup 802A
16415	NPLPN-9	Panelboard	208/120V. 225A. 3ph	E-905				Video/Audio 808
16415	NPLPN-10	Panelboard	208/120V. 400A. 3ph	E-906				Studio 827
16415	NPLPN-11	Panelboard	208/120V. 100A. 3ph	E-906				Elec Room 127B
16415	NPLPS-1	Panelboard	208/120V. 225A. 3ph	E-907				Corridor 204
16415	NPLPS-2	Panelboard	208/120V. 225A. 3ph	E-908				Serology 305
16415	NPLPS-3	Panelboard	208/120V. 100A. 3ph	E-908				Serology 305
16415	NPLPS-4	Panelboard	208/120V. 225A. 3ph	E-908				DNA 319
16415	NPLPS-5	Panelboard	208/120V. 225A. 3ph	E-909				Serology 305
16415	NPLPS-1T	Panelboard	208/120V. 225A. 3ph	E-907				Tool Room 217
16415	NPLPS-6	Panelboard	208/120V. 225A. 3ph	E-909				Serology 305
16415	NPLPS-7	Panelboard	208/120V. 225A. 3ph	E-910				Serology 305
16415	NPLPS-8	Panelboard	208/120V. 225A. 3ph	E-910				DNA 321
16415	NPLPS-9	Panelboard	208/120V. 225A. 3ph	E-911				DNA 322
16415	NPLPS-10	Panelboard	208/120V. 225A. 3ph	E-911				Serology 300
16415	NPLPS-11	Panelboard	208/120V. 100A. 3ph	E-911				Elec Room 127A
16415	NPLPE-1	Panelboard	208/120V. 225A. 3ph	E-901				Corridor 101
16415	NPLPE-3	Panelboard	208/120V. 225A. 3ph	E-901				AV Room 117A
16415	NPLPW-1	Panelboard	208/120V. 225A. 3ph	E-912				Examiner 404
16415	NPLPW-2	Panelboard	208/120V. 400A. 3ph	E-912				Examiner 404
16415	NPLPW-3	Panelboard	208/120V. 400A. 3ph	E-913				Wet Chem 414
16415	NPLPW-4	Panelboard	208/120V. 225A. 3ph	E-913				Examiner 404
16415	NPLPW-5	Panelboard	208/120V. 225A. 3ph	E-914				Examiner 404
16415	NPLPW-6	Panelboard	208/120V. 225A. 3ph	E-914				Trace Evid 400
16415	NPLPW-7	Panelboard	208/120V. 225A. 3ph	E-914				General Off 913
16415	NPLPW-8	Panelboard	208/120V. 400A. 3ph	E-915				Bulk Evid 903
16415	NPLPW-9	Panelboard	208/120V. 225A. 3ph	E-915				Main Elec 929

ELECTRICAL DISTRIBUTION SYSTEM

SPECIFICATION PARAGRAPH NUMBER	TAG NUMBER	NOMENCLATURE	CHARACTERISTICS	DESIGN DRAWING NUMBER	ITEM MANUFACTURER	MODEL NUMBER	SERIAL OR PART NUMBER	LOCATION
16263	Gen-1	Generator No.1	480/277V1500kW/1875kVA	E-803				Walkin Outdoor Encl.
16375	UDS-1	Disconnect Switch	1800A-4P, 5W.Nonfused	E-801				
16375	XFMR-1	Transformer	12.47kV-480/277 3000kVA	E-801				Outdoor
16263	BKR-G1	Generator Breaker	2500A.	E-803				
16528	LAN1	Lighting Automation Panel	480/277V.	E-817				Elec Room 127B
16528	LAE1	Lighting Automation Panel	480/277V.	E-817				Elec Room 115
16528	LAS1	Lighting Automation Panel	480/277V.	E-817				Elec Room 127A
16528	LAW1	Lighting Automation Panel	480/277V.	E-817				Elec Room 929

EXHIBIT E-1 DESIGN MASTER EQUIPMENT LIST

ELECTRICAL DISTRIBUTION SYSTEM								
SPECIFICATION PARAGRAPH NUMBER	TAG NUMBER	NOMENCLATURE	CHARACTERISTICS	DESIGN DRAWING NUMBER	ITEM MANUFACTURER	MODEL NUMBER	SERIAL OR PART NUMBER	LOCATION
16415	SWBD-1	Switchboard	480/277V 4000A. 3ph	E-801				Elec Room 929
16415	SWBD-2	Switchboard	480/277V 4000A. 3ph	E-801				Elec Room 929
16415	NPHQN-X1	Transformer	500Kva 480/208-120V.	E-801				Elec Room 929
16415	NPHQW-X1	Transformer	300Kva 480/208-120V.	E-801				Elec Room 929
16415	NPHQE-X1	Transformer	112 1/2Kva 480/208-120V.	E-801				Elec Room 929
16415	NPHQS-X1	Transformer	300Kva 480/208-120V.	E-801				Elec Room 929
16415	NPHQW2	Switchboard	480/277V 800A. 3ph	E-801				Elec Room 929
16415	NPHQW1	Panelboard	480/277V 225A. 3P	E-919				Mech Room 923
16415	NPHLN1	Panelboard	480/277V 225A. 3P	E-917				Elec Room 127B
16415	NPHLS1	Panelboard	480/277V 100A. 3P	E-917				Elec Room 127B
16415	NPHLE1	Panelboard	480/277V 100A. 3P	E-916				Elec Room 127B
16415	NPHLW1	Panelboard	480/277V 100A. 3P	E-917				Elec Room 929
16415	NPHGS1	Panelboard	480/277V 100A. 3P	E-916				Elec Room 127A
16415	NPHGE1	Panelboard	480/277V 225A. 3P	E-916				Elec Room 127B
16415	MCC-1	Motor Control Center	480/277V 1000A. 3P	E-805				Elec Room 929
16410	ATS-1	Automatic Transfer Switch	400AMP	E-808				Closet Room 930
16410	ATS-2	Automatic Transfer Switch	800AMP	E-808				Elec Room 929
16410	ATS-3	Automatic Transfer Switch	1600AMP	E-808				Elec Room 929
16410	ATS-5	Automatic Transfer Switch	400AMP	E-808				Elec Room 929
16410	ATS-6	Automatic Transfer Switch	800AMP	E-809				Elec Room 929
16410	ATS-7	Automatic Transfer Switch	800AMP	E-809				Elec Room 929
16410	ATS-8	Automatic Transfer Switch	800AMP	E-809				Elec Room 929
16410	ATS-9	Automatic Transfer Switch	800AMP	E-809				Elec Room 929
16415	NPLQN-1	Switchboard	208/120V. 1000A. 3ph	E-810				Elec Room 127B
16415	NPLQS-1	Switchboard	208/120V. 1000A. 3ph	E-811				Elec Room 127A
16415	NPLQE-1	Switchboard	208/120V. 400A. 3ph	E-812				Elec Room 115
16415	NPLQW-1	Switchboard	208/120V. 1000A. 3ph	E-813				Elec Room 929

ELECTRICAL DISTRIBUTION SYSTEM								
SPECIFICATIO N PARAGRAPH NUMBER	TAG NUMBER	NOMENCLATURE	CHARACTERISTICS	DESIGN DRAWING NUMBER	ITEM MANUFACT URER	MODEL NUMBER	SERIAL OR PART NUMBER	LOCATION
16415	EPHQW-SB	Switchboard	480/277V. 2500A.3ph	E-803				Elec Room 930
16415	EPHMW-LS	Switchboard	277/480V. 225A. 3ph	E-815				Elec Room 930
16415	EPHLNLS	Panelboard	277/480V.100A. 3ph	E-918				Emer Room 127B
16415	EPHLSLS	Panelboard	277/480V. 100A. 3ph	E-918				Emer Room 127A
16415	EPHLELS	Panelboard	277/480V. 100A. 3ph	E-918				Emer Room 115
16415	EPHLWLS	Panelboard	277/480V.100A. 3ph	E-918				Emer Room 930
16415	SPHQW-SB	Switchboard	480/277V. 800A.3ph	E-804				Elec Room 930
16415	SPHPNSB	Panelboard	480/277V. 600A.3ph	E-923				Elec Room 127B
16415	SPHPWSB	Panelboard	480/277V. 225A.3ph	E-924				Elec Room 930
16415	SPHPSSB	Panelboard	480/277V. 400A.3ph	E-924				Elec Room 127A
16415	SPHPESB	Panelboard	480/277V. 100A.3ph	E-923				Elec Room 115
16415	SPHPNSB-X1	Transformer	30kVA, 480/208-120V	E-804				Elec Room 127B
16415	SPHPWSB-X1	Transformer	75kVA, 480/208-120V	E-804				ELec Room 930
16415	SPHPSSB-X1	Transformer	75kVA, 480/208-120V	E-804				ELec Room 127A
16415	SPSPESB-X1	Transformer	30kVA, 480/208-120V	E-804				Elec Room 115
16415	SPLPNSB	Panelboard	208/120V. 100A.3ph	E-920				Elec Room 127B
16415	SPLPWSB	Panelboard	208/120V. 100A.3ph	E-921				Elec Room 930
16415	SPLPWSB1	Panelboard	208/120V. 100A.3ph	E-921				Security Rm 928
16415	SPLPSSB	Panelboard	208/120V. 225A.3ph	E-922				Elec Room 127A
16415	SPLPESB	Panelboard	208/120V.100A.3ph	E-919				Elec Room 115
16415	UPS-1	Power Supply	208/120V.400A.3ph	E-816				UPS Room 929A
16415	UPLPN1	Panelboard	208/120V.100A.3ph	E-925				Elec Room 127B
16415	UPLPN2	Panelboard	208/120V.100A.3ph	E-925				Computer Rm 805
16415	UPLPS1	Panelboard	208/120V.100A.3ph	E-926				Elec Room 127A
16415	UPLPE1	Panelboard	208/120V.100A.3ph	E-925				Computer Rm 112
16415	UPLPE2	Panelboard	208/120V.225A.3ph	E-925				AV Rm 117A
16415	CHL-1	Chiller No. 1	480/277V. 800A.3ph	E-802				West exterior
16415	CHL-2	Chiller No. 2	480/277V. 800A.3ph	E-801				West exterior
16415	CHL-3	Chiller No. 3	480/277V. 800A.3ph	E-802				West exterior
16415	CHL-4	Chiller No. 4	480/277V. 800A.3ph	E-801				West exterior

8.15 Exhibit E-2 Training Schedule

TRAINING TIME BY EQUIPMENT & EQUIPMENT SYSTEMS	
TRANSFORMER	**O/M Staff Training**
Pad Mount Transformers	2 Hours
Dry Type Transformers	1 Hour
Total Hours	3 Hours

TRAINING TIME BY EQUIPMENT & EQUIPMENT SYSTEMS	
LIGHTING SYSTEM	**O/M Staff Training**
Lighting Control System	8 Hours
Miscellaneous Lighting Fixtures	2 Hours
Total Hours	10 Hours

TRAINING TIME BY EQUIPMENT & EQUIPMENT SYSTEMS	
ELECTRICAL DISTRIBUTION EQUIPMENT	**O/M Staff Training**
Main Substation/Switchboard	8 Hours
Motor Control Switches	2 Hours
UPS System	4 Hours
Miscellaneous Panelboards	4 Hours
Total Hours	19 Hours

VOLUME

9

VOLUME 7 OPERATION AND MAINTENANCE REQUIREMENTS

Management Plan & Systems Operation and Maintenance Manual Templates Appendix A

Specialty Systems

Table of Contents

9.1 General Information

A. The Management Plan & Systems Operation Maintenance Manual Templates are a part of the comprehensive program for operation and maintenance of the US Army Criminal Investigation Laboratory. For detailed information of how this section fits into the overall documentation of a comprehensive operation and maintenance program, reference the following related documents.

1. VOLUME 7 - Operation and Maintenance Statement
2. Appendix A – Management Plan & Systems Operation and Maintenance Manual Templates
3. Drawings and Specifications
4. Equipment Manufacturer's Instructions

B. This volume is not intended to replace contract documents, shop drawings, as-built drawings, or equipment manufacturers' instructions. The intent is to supplement such documents and provide an overall format for organizing the information necessary to operate and maintain the system.

C. For guidance in completing this volume, reference O&M SOW Chapter 1 – 'Statement of Work' and Appendix A Volume 1 – 'Comprehensive Management Plan'.

D. This Volume deals with Specialty Systems of the kind you would find in most crime labs. Forensics laboratories collect, analyze, and interpret evidence involved in the investigation and prosecution of criminal activity. A laboratory must demonstrate that its management, operation, personnel, procedures, equipment, facility, and health and safety procedures meet established standards. Laboratories must be able to implement proficiency testing, training, continuing education, and other programs that improve the laboratory personnel's overall skills and services.

E. A modern fully equipped laboratory increases the organization's ability to keep pace with new technologies and to guarantee only the highest quality forensic services. The Specialty Systems in this section are organized into 3 major categories; Architectural Systems, Laboratory Systems, and Conveying Systems. They consist of accessories and equipment, which are vital to the operation of the Criminal Investigation Laboratory. These are usually specified in divisions 10, 11, 12, 13, and 14 of the Specifications. Each item of equipment serves a specific function, but together the specialties combine to support the services and procedures provided by the US Army Criminal Investigation Laboratory.

F. The following system descriptions are in no particular order of importance, but rather follow the general order of the systems found in VOLUME 7 and the Specifications Manual.

9.2 Specific System Descriptions

A. Projection Screens

1. This facility is equipped with motorized, front viewing projection screens. This type of screen is best used in a room that can be darkened during presentations. The training room can be subdivided into smaller meeting rooms by an operable partition system. The exterior windows are equipped with motorized vertical blinds that may be closed during daylight hours.

2. One of the most important factors in selecting a screen is the light reflectance quality, called gain. Screens are available with matte-white, glass-beaded, and reflective viewing surfaces. Each type has its own advantages and limitations. The screen surface specified for this project provides the optimum combination of gain, contrast, and resolution. It is ideal for data-graphics projectors and tolerates a significantly higher ambient light level than any other front projection screen surface.

3. The motor operated screen with motor in roller is an economical design, and allows the motor to be removed or replaced without removing the screen. The projection screen is electrically operated from a wall-mounted switch.

B. Toilet Partitions and Accessories

1. The toilet partitions and urinal screens meet a commercial grade according to CID-A-A-60003. The compartments are overhead-braced and floor-anchored for maximum security and durability.

2. The plastic-laminate compartments and screens with particleboard cores are resistant to normal wear, acids, and alkalis and resist stains made by felt-tip markers, lipstick, etc. The plastic-laminate surface is easy to maintain with soap and water. To prevent vandals from prying the plastic laminate from its core, and for added durability, stainless steel edges have been provided.

3. The compartments are secured to the walls with manufacturer’s standard brackets. Drywall type walls have been reinforced with wood blocking or metal strapping for added strength.

4. Manufacturers typically coordinate cutouts and reinforcing for toilet accessories such as grab bars and combination tissue dispenser units furnished under another Division 10 Section.

5. The compartments are handicapped accessible and meet the ADA requirements outlined in the Uniform Federal Accessibility Guide.

C. Cubicle Curtains and Tracks

1. The Studio can be subdivided into private compartments with the use of ceiling hung tracks and light tight curtains (black out drapes). The black out drapes are composed of flame resistant, heavy-duty vinyl, laminated to

a durable inner layer. The fabric is resistant to water, most oils, chemicals and greases.

2. The curtains are supported by cubicle tracks similar to the ones you would find in most hospital rooms. The curtains are easily removable for repair or cleaning without the use of a stepladder or special equipment.

3. Since the curtains are taller than normal, the curtain tracks are heavy-duty type extruded aluminum, mounted on hangers. The carriers consist of nylon wheels on stainless steel, with chromium plated steel hooks. This assembly of materials is virtually maintenance free.

D. Raised Floor

1. Changing technology and evolving work styles call for a flexible workplace. Reconfiguration of the electronic equipment must happen fast and be cost effective. Incorporating under floor power, telephone, data, and air distribution with raised flooring can provide you with a flexible, cost-effective foundation for the new workspace.

2. In the Training Room, Computer Room, and Data Closet, the raised floor consists of metal clad cementitious filled composite panels on stringerless pedestals. The panel design combines the tensile strength of steel with the compressive strength of concrete to create the composite structure of a concrete slab, in a lightweight construction. The panels are interchangeable and provide strength and durability.

3. In the Training Room, the concrete core is quiet, with the solid feel of a concrete floor. The field applied carpet tiles match the panel in size, and a variety of designs, patterns, and colors are available to match any type of office décor.

4. In the Computer Room, the composite panels are perfectly suited for heavy rolling loads of computer rooms. The conductive vinyl floor tile protects sensitive electronic devices.

5. The single story facility means that all rooms are located on the ground floor, and access to the various departments occurs without steps. Naturally, the raised floor (access floor) should align with the adjacent floor level. For this reason, the slab on grade has been depressed 6-inches (150 mm) resulting in a very shallow network of support pedestals.

E. Signage

1. Three sign types most often are found in buildings: panel signs, dimensional characters (letters and numbers), and cast-metal plaques. Because of their graphics, signage systems receive extra attention from the designers in order to provide a harmonious building environment. Uniform character style and sizes, colors, mounting heights and method, and sign locations are depicted in the signage schedule and details shown on the drawings. A properly designed signage system includes coordination of

sign type, compliance with local code and sign ordinance requirements, careful selection of materials, effective placement of way finding signs to avoid additional unforeseen signage at the end of a project, and appropriateness of sign applications.

a. The Exterior Signage System provides identification of the site and directional information to building entrances, parking, and service areas. A monument sign, visible from N 31st Street, compliments the building design and identifies the new facility and main entry. Design considerations include message legibility, compatibility with building materials and colors, and low maintenance. Secondary directional signs indicate entry points, handicapped parking spaces, access for delivery vehicles, loading docks, and service entrances. Panel signs are constructed of aluminum with silk-screened images. Letters and plaques are cast bronze.

b. The Interior Signage System consists of building directories, and panel signs typically used as room signs, occupancy signs, toilet room signs, code signs, and way finding signs in interior environments. Panel signs are the most economical and the easiest to install and maintain. Permanent room signs are constructed of molded plastic with raised letters or pictograms, accompanied with Grade 2 Braille. Changeable message strips consist of computer generated paper inserts; this enables the Owner to change the message as often as necessary without incurring additional costs, while maintaining consistency in the signage system. The building directory is provided with a listing of areas, offices, and personnel located within the facility. The unit is a non-illuminated name-strip directory featuring an extruded aluminum frame and hinged glass door.

F. Steel Clothing Lockers

1. Wardrobe type lockers are provided in the employee locker rooms for individual short-term use and security of personal belongings. The pre-finished, two-tier all steel construction provides ample space, durability, and security while conserving valuable floor space. The lockers are equipped with shelf, hanging rod, double prong hook, and built-in padlock. Slots in the top and bottom flanges of the door provide ventilation.

G. Metal Canopies

1. Metal canopies like the ones along the west elevation, are lightweight, economical, low maintenance coverings frequently used to protect openings and service areas during inclement weather.

2. The metal canopy system consists of pre-engineered, all aluminum beams and roof deck components. The system has a factory baked on fluoropolymer finish for long-term carefree installation.

3. Water flow is directed from deck into beams (wet beams), which are connected to downspouts, for discharge at ground level.

H. Operable Panel Partitions

1. By definition, operable panel partitions are usually full height to ceiling, acoustically rated, and are commonly fabricated to custom dimensions. Folding doors are not rated for acoustical performance and are limited to stock sizes. In contrast, the panels provide a flat surface similar to the surrounding walls as opposed to a corrugated appearance. Overhead framing secured to the building structure must support the operable panel system.

2. For the Training Room, the operable panel partitions serve primarily as physical, visual, and sound barriers, dividing the large room into functional parts and enhancing the room's adaptability and use for multiple purposes.

3. The operable panel system for the Training Room consists of individual, manually operated panels, supported on tracks and carriers, or trolleys. The track layout is shown on the reflected ceiling plan. This arrangement allows multi-directional use of the panels for optimum room flexibility. The panels may be arranged in any configuration along the tracks, and the pass door can be located where needed. The panels can also be stored out of sight in a recessed niche.

4. The panels consist of a tackable base, laminated to an acoustical backing, and mounted in a steel or aluminum frame with a vinyl fabric applied to both panel faces. The sound-insulating qualities satisfy the design requirements for a sound transmission rating up to 53 and noise reduction coefficient of .75.

5. The tracks are aluminum top-supported and connected to the structural support by threaded rods. This arrangement allows the panels to be set in place without the need for permanent floor guides. In-place operable panel partitions are secured by extending a retractable acoustical bottom seal that exerts pressure against the floor to both lock the partition in place and provide a sound seal, or by simultaneously extending top and bottom retractable, mechanical, acoustical seals that exert pressure against both the floor and the track.

6. Markerboard and tackboard work surfaces permanently attached to the panels enhance the use of the operable partition system.

I. Mobile Storage Systems

1. Mobile storage sometimes referred to as high-density storage or compact systems, work on a very simple premise; nearly 50 percent of conventional storage shelving areas are wasted on aisles. By putting wheeled shelving units on tracks, unnecessary aisles can be eliminated and storage efficiency can be increased by up to 80 percent. Increased storage density means reduced space and operating costs, and you get more room for other more productive uses.

2. Mechanical assist units like the ones in Room 909 adjacent to the Processing Area, provide a simple, cost and energy efficient means to increase storage and filing capacity in the Criminal Investigation Laboratory.

3. The mechanical assist system is operated by an easy-to-use and ergonomically designed low-geared hand wheel allowing one or multiple storage units to be moved with little effort. For example, one pound of effort will move a 4,000-pound load. Operating the hand wheel transmits power through a chain sprocket drive to drive the wheels. The driving system is required to provide uniform movement along the total length of the carriage.

4. The exposed parts of the storage units are baked-enamel finish with plastic laminate end panels. The units are available in a variety of colors and finishes to complement the office décor.

5. Maintenance of metal storage shelving is crucial to its longevity and performance. The shelving should be periodically inspected for loose fasteners, damage, proper connections, and loading maximums. Posts are especially important to the load-carrying capacity of shelving and should be repaired or replaced promptly if damaged.

J. Toilet Accessories

1. Various types of dispensers, disposal units, and other type devices for personal hygiene are commonly used in commercial washroom facilities. The units are almost exclusively constructed of type 304 stainless steel for durability, sanitation, and overall clean appearance.

2. Available from a number of manufacturers, the units are universal in design to accommodate the corresponding supplies available on the market.

3. As places of public accommodation, the Americans with Disabilities Act and the Uniform Federal Accessibility Guide mandate that public restrooms must be accessible to the disabled. The toilet accessories and their locations have been coordinated to ensure required clearances are maintained. Mounting heights shown on the drawings comply with side and forward reach dimension requirements.

K. Kitchen Equipment

1. Major residential appliances in combination with the cabinets and countertops work as a system to provide break room facilities for the employees. Electric type residential appliances with stainless steel finish are easy to maintain and are listed by Underwriters Laboratories. The appliances of the type selected for the Criminal Investigation Laboratory are familiar to most people, and they do not require any special knowledge on their use and operation. For this reason, they are perfectly suited for use in a commercial project such as the laboratory.

2. A well-planned kitchen is efficient, attractive, and easy to maintain. The U-shaped kitchen (room 118) is designed much like a residential kitchen. To design an efficient kitchen, the designer must consider the function, basic shape, décor, size, and location of the equipment. The major appliances are arranged around the traditional work triangle where the refrigerator, sink, and range form a triangle 12 to 22 feet (3.6 to 6.6 m) in length.

3. Wall and base cabinets are factory-fabricated of wood for a warm residential appearance. The cabinets, drawers, and adjustable shelves provide ample storage for break room supplies, such as coffee, cups, and utensils. Countertops consist of plywood clad in high-pressure plastic laminate. The cabinets are equipped with heavy-duty hardware for long lasting trouble free use

L. Darkroom Equipment

1. The darkroom equipment consists of cabinets, countertops, stainless steel sinks, safelights, tray processing sinks, silver recovery systems, acid neutralization tanks, water control panels, chemical storage shelves, and revolving darkroom doors. The government will provide film-processing equipment for black and white, and color print development. The darkroom equipment is specifically designed and manufactured using special materials and construction requirements necessary for photographic laboratory procedures. Safety and comfort are primary considerations in darkroom design. The darkrooms have been carefully planned to provide adequate ventilation, environmental safety, silver recovery, and safelight illumination.

2. The tray processing sinks and the water control panel deliver safe tempered water necessary for quality print processing. The silver recovery system helps photographic labs meet tough environmental compliance by reducing the total silver discharge to less than 1 ppm. The recovery system is compact and fits under most darkroom processing sinks. The unit is in a self-contained spill tray mounted to a slide-out shelf mechanism for ease of solution dumping and obstruction-free movement. The acid neutralization tank is designed to dilute and neutralize harmful acids and

precipitates into sludge causing it to fall to the bottom of the unit and thus protecting the water supply.

3. Safelights serve two purposes: to keep the photographer from bumping into furnishings, trays, equipment, and bottles of chemicals in the darkroom; and second, to inspect the progress of development of light sensitive material. The darkroom safelight of the type specified for this project is not a conventional safelight. Instead of flowing current through tungsten, producing white light, the current activates sodium gas, which emits a monochromatic light. The safelight is designed to flood the entire darkroom with a soft, evenly diffused indirect light for maximum visibility and comfort. This is done by suspending the safelight from the ceiling in the approximate center of the room with the bottom of the safelight about seven feet (2140 mm) from the floor.

M. Firing Range Equipment

1. The southeast portion of the Crime Lab is devoted to firearms / toolmarks identification. Firearms identification can be defined as the identification of fired bullets, cartridge cases or other ammunition components as having been fired from a specific firearm. Firearms identification is actually a form of tool mark identification where the firearm acts as a tool to leave impressed or striated marks on the various ammunition components that come into contact with the firearm. Firearms evidence submitted to the lab’s firearms section will typically include a firearm, fired bullets, spent cartridge cases, spent shot, live ammunition, clothing, and any other component associated with the particular investigation.

2. In addition to comparing ammunition components to firearms, firearm examiners conduct other examinations that usually include the following: testing firearms to determine if they function properly; examine clothing and other items for gunshot residues and shot patterns; determine caliber and manufacturer of ammunition components; determine the manufacturer of firearms that may have fire a particular bullet or cartridge case. The crime lab is equipped with firing range equipment to support and perform specific scientific examinations upon the evidence submitted.

3. Bullet Recovery Tank: a submitted firearm will be fired several times using a water tank like the one specified. Friction from passing through the water slows the bullets down and they end up on the bottom of the tank. The tank is constructed of 10 mm stainless steel and approximately 710 mm wide by 2525 mm long by 1200 mm high. The tank is ducted to the exhaust system for evacuation of the gunshot residues resulting from the use of the tank.

4. Wet Bullet Trap: the snail bullet trap, as it is sometimes referred to, is an environmentally safe method of capturing fired bullets. The customized deceleration chamber is circular in design to reduce bullet break up and to

allow the bullet to forfeit its kinetic energy and drop into a container ready for recycling and easy retrieval.

5. Ballistic Baffle System: safety for the shooter is most important inside the firing range. Ballistic baffles consisting of plywood and steel panels are suspended from the ceiling at an appropriate angle to capture bullets from misdirected shots or other projectiles.

6. Target Retrieval System is an automatically operated type, consisting of an overhead track, drive unit, local control station, and target carriers. The control unit is designed for easy access to components within the case for quick serviceability.

N. Laboratory Equipment, Fume Hoods, and Laboratory Furnishings.

1. Forensic science requires unique facilities to meet the scientifically demanding environments in a structure that supports evidence handling procedures and protocols. Properly designed and furnished with the latest modern equipment, laboratories are the essential facilities for any crime lab. The Criminal Investigation Lab has been designed to ensure a functional environment that minimizes potential hazards to the workers in the immediate area and throughout the facility. Standard guidelines include hygienic and operational practices that are critical in providing for a safe work environment and assuring a viable research product is produced. Ample space must be provided for the safe conduct of laboratory procedures. Storage space must be adequate to hold supplies for immediate use and thus prevent clutter on bench tops and in aisles. Additional long-term storage space, conveniently located adjacent to the work areas, has been provided with a variety of shelving types and specialty storage cabinets for chemical storage.

2. Laboratories must be under negative air pressure with respect to adjacencies with adequate make-up air provided. A few laboratory spaces such as PCR suite, Serology, and collections rooms in Trace Evidence, are provided with positive pressure relative to surrounding spaces. Chemical fume hoods and biological safety cabinets must be vented through rooftop exhausts in a manner that prevents re-entrainment of contaminants. Biological safety cabinets must be the correct type for the research project. Cabinets must be inspected and have a performance evaluation and annual certification by a certified company to assure that the units were installed correctly, are functioning as designed, and comply with the standards of the manufacturer. Containment devices such as ventilation workstations and ductless fume enclosures have been designed in the examination areas to diminish risk of cross contamination. Flexible exhaust ducts have been provided at specific locations for laboratory activities or instrumentation.

3. Washbasins, specialty sinks, and emergency eye wash stations must be provided in each laboratory space. Laboratory furniture, fixtures, and bench tops must be made of non-combustible materials, and be sturdy,

impervious to water, and resistant to disinfectants, acids, alkalis, organic solvents, and moderate heat. Autoclaves and sterilizers must be provided with proper ventilation of steam and heat.

4. Sterilizing Equipment: single door, isothermal unit, designed for low temperature sterilization of nonporous heat and moisture stabile goods, sterilization of liquids and media in borosilicate glass containers with vented closures and decontamination of supplies after laboratory procedures. Unit includes integral stainless steel steam generator.

5. Glassware Washer: cabinet type washer designed for thorough cleaning of laboratory glassware, plastic, and metal goods used in research, production support, and quality control laboratories. The washer is preprogrammed with three adjustable cycles; light, medium, and heavy. The all stainless steel unit is electrically operated, single door washer meeting UL Standard 544.

6. Biological Safety Cabinet: Class II, type B3 biological safety cabinet designed for sterile preparation and biological experimentation involving agents of low and moderate risk. Vented to the outdoors through the facility exhaust system, the cabinets are equipped with HEPA filters rated at 99.99 percent minimum efficiency.

7. Laminar Flow Clean Bench: horizontal laminar flow clean bench, which provides a HEPA, filtered airflow across the work area, and a particulate-free work surface. Because only filtered air crosses the work surface, the cabinet is ideal for a range of life science and industrial laboratory and process applications where clean air and product protections are essential. The cabinet includes a corrosion-resistant type 304 stainless steel work surface with a white baked enamel finish on the exterior enclosure. The unit meets Class 100 cleanliness.

O. Fume Hoods and Accessories

1. Fume hoods provide an enclosed, ventilated workspace in the laboratory for activities involving toxic or disagreeable gases, aerosols, or smoke. Fume hoods operate on the principle of continuous airflow through the front face, passing through the enclosure, and exiting at the exhaust collar. The primary function of fume hoods is to contain contaminants within the enclosed workspace and exhaust them from the workspace for the safety of personnel and surroundings. The open by-pass type fume hoods are pre-piped and pre-wired for cold water, gas, compressed air, vacuum, and electrical receptacles. The wider hoods have combination vertical/horizontal sashes to allow full access to both the width and height of the hood for optional set-ups. Chemical fume hood liners are reinforced polyester, and hydrofluoric fume hood liners are PVC or polypropylene. Work surfaces are epoxy resin. The fume hoods are equipped with airflow indicators and alarms so the hood operator will know immediately if the hood exhaust is malfunctioning or has lost power.

2. Ductless fume enclosures are designed for forensic applications such as print fuming, analysis of fingerprints and gunshot patterns, weighing dangerous powders, and drug identification. The unit features an advanced monitoring system consisting of digital display of airflow.

3. The Ventilated Work Station is a flexible, portable workstation designed for forensic applications such as slide staining and cover slipping, drug and chemical analysis, pipetting, graphic arts, and balances. The compact, lightweight workstation offers protection from harmful vapors of everyday chemical solutions and powders that are routinely encountered when processing evidence for latent prints. The unit conforms to OSHA requirements.

4. The Fume Extractors are designed for mounting on the wall, ceiling, or bench top for localized ventilation of smoke, dust, chemicals, solvents, and fumes from the workspace. The units are constructed of durable, scratch resistant polypropylene with aluminum parts. The unit has an approximate reach of 8 feet (2.4 m).

P. Laboratory Specialty Sinks:

1. One-piece polyester resin and type 316 stainless steel sinks for special procedures and processes.

Q. Laboratory Furnishings

1. The Criminal Investigation lab is designed as a modular laboratory, arranged in blocks of space, or modules, responding to the dimensions of standard modular-sized cabinets and equipment. Steel casework with wood door and drawer fronts has been customized for use throughout most of the laboratory spaces. The marriage of metal cabinets with wood veneer facings is an economical application where laboratory functions will change occasionally, without sacrificing the beauty and warmth of the more expensive wood casework. Moveable tables, adjustable height tables, and flexible laboratory casework systems provide flexible workstations in the exam areas of each laboratory space.

2. Numerous materials are available for laboratory countertops with varying degrees of chemical, stain, heat, impact, and scratch resistance as well as varying costs. The conditions to which the countertops will be subjected partly determine which materials should be used. Bench top work surfaces in laboratory spaces where fume hoods or chemically rated biological safety cabinets are used will be epoxy resin. Solid composite phenolic is offered as an option. Stainless steel work surfaces will be used where biologically contaminated evidence is to be placed for examination. Chemical resistant plastic laminate is appropriate for general countertop applications not subjected to excessive chemical exposures or prolonged high temperatures. Plastic laminate has been selected for use in most laboratories that do not demand resistance to strong chemicals or extreme

heat. Laminated maple bench work surfaces are provided in areas requiring physical examination such as in the firearms/toolmarks and vehicle examination workbench.

3. Laboratory sinks and cup sinks are epoxy resin in all epoxy resin countertops. Stainless steel sinks are provided at other locations.

R. Window Treatments

1. The private offices, training room, and some of the labs are equipped with blinds or shades for privacy, light control, glare reduction, and to a lesser degree, sound control and energy conservation.

2. The motorized vertical louver blinds in the training room can provide a wide range of light control and privacy. The PVC vanes may be stacked, tilted perpendicular, tilted at an angle, or tilted parallel to the glass; privacy ranges from none to maximum along with light control.

3. Some labs are equipped with manually operated roller shades, installed in the vertical plane above the corridor windows, and operating from a single roller. The roller shades are fabricated from blackout shade fabric designed to eliminate all visible light gaps when shades are fully closed. The roller shades have a neat, uniform appearance and when fully retracted, they are completely hidden in the headbox.

S. Cold Storage Rooms

1. These consist of pre-fabricated, energy efficient walk-in coolers used for evidence storage requiring temperature and humidity control. The units include self-contained performance refrigeration equipment and accessories for the most efficient and reliable installation possible. The cold rooms are pre-wired for power and lighting.

2. Modular wall, floor, and ceiling panels are manufactured from the highest quality material selected for function, efficiency, and aesthetics. Panels consist of tongue and groove construction with two rows of PVC gaskets at each panel joint to allow for a snug and air tight fit. Steel cam-action fasteners are used to securely lock each panel together. The polyurethane foam insulation is the ultimate insulating material currently available for walk-in construction. The panels are finished in white, stucco embossed galvanized steel for long lasting maintenance free installation.

3. The cold rooms are equipped with wall mounted stainless steel open wire shelving

T. Dock Lift

1. MH 29.1, produced by the Lift Manufacturers' Product Section of the Material Handling Industry of America (MHIA), is the standard for industrial scissors lifts. Safety in scissors lift operation is a primary concern in MH 29.1. When expected truck-bed heights and the type of material-handling equipment vary, a scissors type dock lift serves the

purpose by providing a level-working platform. Dock bumpers are almost always necessary to cushion impact forces and absorb kinetic energy, while minimizing damage to the dock structure and to the truck and its contents.

2. The molded-rubber dock bumpers are simply bolted to the front edge of the dock. They are clean in appearance and easily replaced when necessary.

3. A properly designed dock lift is capable of servicing all types of material handling vehicles and still provides flexibility for different truck-bed heights. The pit mounted lift is flush with the surrounding dock when not in use.

4. The hydraulic lift is fabricated from structural steel and heavy plate steel, and is equipped with hinged bridge, handrails, and safety chains and other safety devices. The lift has a rated capacity of 2268 kg, with a vertical travel of 1.27 m. The power unit is self-contained and remotely located.

U. Vehicle Lift

1. The frame engaging lift requires minimal floor space, and accommodates most vehicles, up to 9,000-pound (4082 kg) capacity. The three-position flip-up adapters and adjustable swing arms can be quickly set for all types of cars, vans, and light trucks.

2. Its ease of service, out-of-the-way space saving convenience, and long list of features and benefits make this lift a production solution for the Crime Lab. By eliminating the seals and packings and over 60 gallons (227 liters) of oil, and designing it with fewer moving parts, there is less chance that something will go wrong.

3. The specified lift addresses environmental concerns with a unique system featuring a polymer composite containment housing, innovative protection on the guide pistons, a flexible entry boot, and a leak resistant cover seal to completely protect the lift from the environment and the environment from the lift. A removable non-skid coated cover plate allows easy access to the interior of the system.

V. Overhead Crane

1. Overhead monorail system with electric chain hoist. The monorail system is rated at 3 metric tons.

9.3 Theory of Operation

A. This section focuses on three interrelated specialty systems necessary for the quality performance, process application, and functional operation of the laboratories and related spaces within the four walls of the crime lab. The crime lab experts require specialized equipment and support facilities to receive, handle, identify, store, and process the collected evidence, all in a safe environment. The crime lab must be comfortable for the employees and conducive to efficient, productive work habits.

B. Architectural Systems for the project are organized under training, support facilities, and utilitarian use. Unlike the specialty equipment and systems required in the laboratories, the architectural systems are designed and adapted for general use in operating the facility. Training and continuing education are vital to the ongoing success of any crime lab. Processes and methods for evidence testing will forever change since the events of September 11. Disciplines within forensic science are changing as they improve and evolve with technological advancement and new analytical techniques. A properly designed Training Room must be flexible, adaptable to changing technology, and must be suitable for a variety of audio and visual presentation media. The kitchen, employee lounge, and locker rooms are conveniently located next to the Training Room to support the need for social spaces and to encourage informal interaction with peers. Signage throughout the facility, glass artwork in the lobby, and the unique logo at the front door reinforce the lab's mission; "Justice Through Science."

1. The Training Room responds to the need for effective space design through the use of ceiling mounted projection screens, operable partitions to subdivide the training room into smaller meeting rooms, and motorized window blinds to control daylight, and set up the space for effective presentations. The entire room is situated on individual access floor panels that can be reconfigured to satisfy the functional requirements of the training program.

2. Locker rooms equipped with showers encourage employee physical fitness and personal hygiene. The kitchen and lounge areas isolate eating, drinking, and smoking functions from the labs. Hygienic practices are also necessary to minimize or eliminate the risk of occupational exposure to potentially infectious substances, and cross contamination.

C. Laboratory Systems consisting of laboratory process equipment, exhaust and containment devices, laboratory furnishings, darkroom equipment, firing range equipment, and environmental rooms are the essential facilities for any criminal investigation laboratory. The various components are built into each laboratory to serve a particular purpose. The crime lab at Fort Gillem is one of the most comprehensive of its kind in the Department of Defense. The structure will accommodate seven investigative divisions: Latent Prints, Drug Chemistry, Trace Evidence, Serology, Questioned Documents, Firearms/Toolmarks, and Imaging & Tech Support. The lab performs DNA testing, handwriting analysis, fingerprinting and impressions, drug testing, bullets and firearms are studied, and computers are dismantled for computer crime evidence. Crime labs are by nature high throughput analytical work centers that must process large amounts and varying types of materials.

1. Laboratory Equipment: the sterilizers, glassware washer, biological safety cabinets, and laminar flow clean benches are located in the Serology

Division where DNA and physiological fluids such as blood, semen, and saliva are tested for genetic markers. The ventilated work stations, ductless fume enclosure, flexible work stations, and instrument carts are found throughout the Drug Chemistry and Questioned Documents Division where scientists use sophisticated instruments and techniques to analyze the drug samples seized by law enforcement officers. Specialty fiberglass and stainless steel sinks in Latent Prints provide oversized washbasins for examination of two or three-dimensional forms of detailed footwear or tire tread impressions.

2. Laboratory Exhaust Systems: fume hoods and other type exhaust devices are used to ventilate each of the seven investigative divisions. Additionally, the Instrument Labs for example are equipped with flexible fume extractors for task-oriented and isolated test procedures on small items of evidence.

3. Laboratory Casework and Accessories: One of the key issues in the design of the new crime lab focuses on modular design and flexibility. Due to rapid changes in instrumentation and laboratory processes, the crime lab has been designed with more flexible and generic laboratory layouts. Flexible work stations, adjustable height tables, portable work surfaces, rolling instrument carts, as well as standard modular casework help define the individual character of the seven investigative divisions.

4. The Darkroom Equipment serves the Imaging & Tech Support Division of the crime lab with three fully furnished darkrooms. There is little doubt that images are a crucial part of modern criminal investigations, and that imaging is growing in importance in the practice of law enforcement. Forensic imaging involves both traditional film and digitized images. The photographic processing equipment supports the traditional film sector of the imaging lab. The imaging services provided by the lab are varied and can be everything from accident reconstruction to traditional close-up and photomicrography imaging. Forensic document examinations, or questioned documents, are also done by some visual means. Non-destructive, restorative techniques for documents that have aged or that have been obliterated by stains can be done as well. Through imaging methods, fire damaged documents may be fully or partially restored to a more readable and much more stable state.

5. The firing range equipment supports the Firearms/Toolmarks Division of the crime lab. Firearm experts perform specific scientific examinations on many different types of evidence collected at crime scenes, autopsies, etc. Once the examinations are completed reports detailing their findings are forwarded to the investigating officer and eventually to all parties involved in any subsequent criminal proceedings. Firearms examiners finish their involvement of a case by presenting their findings in a court of law.

6. Trace evidence must be secured and protected from loss, damage, and contamination. Cold Storage Rooms and smaller localized refrigerators and freezers are strategically placed in Serology and Trace Evidence, providing a continuous temperature controlled environment for the evidence.

D. Conveying Systems play a part in the operation of crime labs when the objects submitted for evidence testing arrive in any size, shape, and form. Bulk Evidence Processing can accommodate anything from automobiles, trucks, portions of buildings, and heavy objects too large for other parts of the lab. From the point of delivery to the possible dismantling and transport of the bulk evidence, the loading dock, vehicle lift, and motorized chain hoist facilitate handling of submitted evidence too heavy for human manpower.

1. The scissors type dock lift is compact and versatile, and eliminates the need for a variety of dock equipment. The dock lift adjusts to virtually any truck height, and is compatible with most material handling equipment such as pallet jacks, handcarts, and fork lifts.

2. The in-ground vehicle lift is self-contained, compact, and is easier to operate and maintain than conventional hydraulic systems. Unlike most vehicle maintenance service stations, the crime lab will use the vehicle lift intermittently as the need arises. The lift must be easy to operate by unskilled technicians and a changing work force. Training of new personnel must be quick and effective, and adherence to all safety procedures is of utmost importance.

3. Located next to the vehicle lift, the overhead crane is capable of lifting and transporting heavy objects from point of origin to an area within the facility, for testing and further evaluation. The crane or hoist rides along a monorail that extends from the loading dock to the upper limit of the Bulk Evidence Processing Area.

9.4 Operations

A. The contractor shall provide and incorporate the following information into this Section for each system identified in this Volume.

1. Operations: The operating instructions shall include equipment and/or system layouts showing all piping, wiring, breakers, devices, valves, dampers, controls, etc., complete with functional diagrams, schematics, isometrics, and data to explain the detailed operation and control of each individual piece of equipment and/or system, including system components. Layouts shall show the location within the facility of controls, valves, switches, dampers, etc., by reference to site location, room name and number, or other clear and concise directions for locating them. Operator data may be identical to posted data and framed instructions, but shall be prepared as a part of the O&M manuals. The instructions shall include:

a. Initial adjustments and control settings

b. Precautions and pre-checks to be executed prior to startup of equipment and/or system, including safety devices, monitoring devices, and control sequence.

c. Step-by-step sequential procedures for startup and normal operation checks for satisfactory operation. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the operating instructions and fluffed for the attention of the operator. Procedures shall include test, normal, and automatic modes.

d. Procedures for normal and emergency shutdown of equipment and/or systems. The instructions shall include any procedures necessary for placing the equipment and/or system on standby or preparing the equipment and/or system for startup at a later time. Procedures shall include test, normal, and automatic modes.

e. Procedures for isolating individual equipment from the system and bringing individual equipment on line once the system is operating.

f. Operational logs and records requirements.

9.5 Preventive Maintenance

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Preventive Maintenance: Recommended procedures shall indicate PM (e.g., lubrication, checks, adjustments, etc.) and good-housekeeping practices which should be performed by operating personnel, as well as more complex maintenance procedures which would normally be performed only by trained maintenance personnel. The procedures shall be accompanied by a schedule indicating timeframes or operating hours for specific maintenance to be accomplished. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the maintenance procedures and flagged for the attention of personnel. The procedures shall include necessary operating instructions for taking equipment off-line, on-line, and putting equipment on standby. The instructions shall address all material, equipment, and system data needed to perform maintenance work and shall include, but not be limited to, manufacturers' bulletins, catalogs, and descriptive data; copies of approved test plans, including logs and records of performance acceptance test results and actual adjustments made during final acceptance and inspection; system layouts, including block, wiring, control, and isometric diagrams; schematic items within the facility; and interrelationships with other items of the system.

2. Schedules indicating timeframes or operating hours for initiating operator maintenance and adjustments and including manufacturer's recommended major maintenance requirements shall be provided. Emergency adjustments shall be included and flagged for the operator's attention. The instructions shall also include procedures for emergency repairs that could be performed by operating personnel.

9.6 Trouble Analysis

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Trouble Analysis procedures for locating and correcting the trouble shall be presented in a step-by-step format. Repair procedures shall be keyed to a troubleshooting guide outlined in three columns with the following headings:

Trouble/Symptom	**Probable Cause(s)**	**Corrective Action**
The indication or symptom of trouble	The instructions, including test hookups, necessary to determine the cause(s)	Procedures for restoring the system to operating condition, or cross reference to where the procedure is written in SOMM

2. The procedures shall clearly indicate a major repair activity, which should be performed only in a shop or factory, as opposed to normal repair work, which may be performed on-site or with equipment online. The procedures shall also clearly indicate the limit of repair work that may be performed by maintenance personnel during the warranty period without voiding warranty provisions. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the repair procedures and flagged for the attention of personnel.

9.7 Unscheduled/Corrective Maintenance

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Unscheduled/Corrective Maintenance and Checkout Procedures: Procedures for troubleshooting and isolation, replacement, checkout, and integration of equipment within the system shall be provided.

2. Trouble Analysis: Procedures for troubleshooting of malfunctions that might occur during operation of the system shall be provided. Troubleshooting data, and fault isolation techniques, shall state the following:

a. The indication or symptom of trouble;

b. The instructions, including test hookups, necessary to determine the cause; and

c. Procedures for restoring the system to operating condition.

3. Troubleshooting shall be documented to the extent necessary to locate the faulty piece of equipment within the system. Information may be in chart form, in logic tree form, or in tabular format with appropriate headings.

4. Isolation, Replacement, Checkout, and Integration: Procedures for isolation, replacement, checkout, and integration of the equipment within the system shall be provided. Test, adjustment, and checkout data, after replacement, shall be included.

9.8 Repair Parts and Special Tools and Equipment

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Repair Parts List: A complete list of repair parts and supplies shall be provided. The list shall include all parts and components of individual pieces of equipment and all parts and components of each system and shall identify such items as nomenclature of part, model number, circuit of component identification, etc. Parts and supplies lists shall be included within each volume of maintenance instructions. Further, a master list of repair parts and supplies recommended from each manufacturer for one year of operation, including source of supply, shall be sub-listed with each instruction. The Contractor shall also list the sources of supply for all parts and supplies, including name of supplier/manufacturer, address, and telephone number. If the parts and supplies are not normally stocked locally, necessary procurement lead-time shall also be a part of the listing.

2. Special Tools and Test Equipment List: A list of all special tools and test, measurement, and diagnostic equipment required for system level maintenance shall be included. For the purposes of this specification, the phrase “special tools and test, measurement, and diagnostic equipment” is used to identify all nonstandard tools and equipment designed and developed by the manufacturer and others to perform maintenance, test/calibration, diagnostic/prognostic analysis, and other related support of the equipment, as well as nonstandard tools required for installation, acceptance testing, and successful O&M. Frequency and method of calibration shall be indicated for all special tools, equipment and test equipment items that require calibration. Necessary standards shall be listed immediately after each item that requires calibration.

9.9 Vendor Data/Acceptance Tests

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Vendor Data: A complete set of data, provided by the equipment manufacturer, required for operation, maintenance and checkout shall be included and referenced to the appropriate specification number. Their data may consist of manufacturers' brochures, O&M manuals, catalogs, drawings, service bulletins, and illustrated parts lists necessary to support the O&M of the end item of equipment and assemblies.
2. A record of all Systems' Acceptance Tests shall be included in this section.

9.10 Warranty Information

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. Warranty Information: In addition to the general warranty required and provided under the contract, the O&M manuals shall include any specific warranties required by other sections of the Technical Specifications and other warranties normally provided with the particular piece of equipment or system. Warranties that are normally provided by manufacturers and which are beyond the warranty for construction shall be specifically noted.

9.11 Design Master Equipment List

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. A completed master equipment list with guidance offered in Volume 1 - Comprehensive Management Plan. Exhibit MS-1 See information on the preparation of the Management Plan & Systems Operation and Maintenance Manual for further instructions on the preparation of this list.
2. Reference Exhibit SS-1. All manufacturer's data on the operation and maintenance of the equipment.

9.12 Training Requirements

A. The Contractor shall provide and incorporate the following information into this Section for each system as identified in this Volume.

1. A training schedule in accordance with guidance offered in Volume 1 - Comprehensive Management Plan.
2. Reference Exhibit SS-2 for guidance in the preparation of this schedule.

9.13 Exhibits

1. SS-1 Design Master Equipment List
2. SS-2 Training Schedule

9.14 Exhibit SS-1 Design Master Equipment List

Equipment Identification

SPECIFICATION PARAGRAPH NUMBER	DESIGN DRAWING NUMBER	LOCATION	TAG NUMBER	NOMENCLATURE	CHARACTERISTICS	ITEM MANUFACTURER	MODEL NUMBER	SERIAL OR PART NUMBER
10100 - 2.10				Projection Screen				
10652 - 2.1				Operable Panel Partition				
10672 - All				Mobile Storage System				
11401 - 2.1.2				Refrigerator				
11401 - 2.1.3				Microwave Hood Comb.				
11401 - 2.1.4				Trash Compactor				
11401 - 2.1.5				Electric Range				
11401 - 2.1.6				Dishwasher				
11470 - 2.5				Safelights				
11470 - 2.7				Tray Processing Sinks				
11470 - 2.9				Silver Recovery Systems				
11470 - 2.10				Acid Neutralization				
11470 - 2.11				Water Control Panels				
11486 - 2.4				Bullet Recovery Tank				
11486 - 2.5				Wet Bullet Trap				
11486 - 2.7				Target Retrieval System				
11600 - 2.2				Small Sterilizer				
11600 - 2.2				Medium Sterilizer				
11600 - 2.3				Glassware Washer				
11600 - 2.4				Biological Safety Cabinets				
11600 - 2.5				Laminar Flow Clean Bench				
11600 - 2.6				Fume Extractor Arms				
11600 - 2.7				Ductless Fume Enclosure				
11600 - 2.8				Ventilated Work Station				

11600 - 2.10				Lab Fiberglass Sinks				
11600 - 2.10				Lab Stainless Steel Sinks				
11600 - 2.13				Safety Shelving				
11600 - 2.14				Gas Cylinder Restraints				
11600 - 2.15				Spill Deck				
11600 - 2.16				Roller Table				
11600 - 2.17				Lab Refrigerators				
11600 - 2.17				Lab Freezers				
11610 - 2.2				Fume Hoods				
11610 - 2.5				Stainless Steel Snorkels				
12350 - 2.5				Adjustable Lab Tables				
12350 - 2.12				Lab Pegboards				
12350 - 2.14				Paper Dispenser/Cutter				
12350 -2.15				Safety Cabinets				
12350 - 2.20				Instrument Carts				
12350 - 2.21				Flexible Work Stations				
12490 - 2.1				Motorized Vertical Blinds				
12490 - 2.2				Roller Shades				
13038 - 2.1				Cold Storage Rooms				
11162 - All				Dock Lift				
14450 - All				Vehicle Lift				
14622 - All				Overhead Crane				

9.15 Exhibit SS-2 Training Schedule

TRAINING TIME BY EQUIPMENT & EQUIPMENT SYSTEMS				Number of Hours		Schedule	
Specification Section	Equipment or Systems	Tag Number	O/M Staff Training	Classroom	Site	Planned	Actual
10100	Projection Screen						
10652	Operable Panel Partition						
10672	Mobile Storage System						
11401	Microwave Hood Combination						
11401	Trash Compactor						
11401	Electric Range						
11401	Dishwasher						
11470	Safelights						
11470	Tray Processing Sinks						
11470	Silver Recovery Systems						
11470	Acid Neutralization Tank						
11470	Water Control Panels						
11486	Bullet Recovery Tank						
11486	Wet Bullet Trap						
11486	Target Retrieval System						
11600	Sterilzers						
11600	Glassware Washer						
11600	Biological Safety Cabinets						
11600	Laminar Flow Clean Benches						
11600	Fume Extractor Arms						
11600	Ductless Fume Enclosure						
11600	Ventilated Work Station						
11610	Fume Hoods						
11610	Stainless Steel Snorkels						
12350	Adjustable Lab Tables						
12490	Motorized Blinds						
13038	Cold Storage Rooms						
11162	Dock Lift						
14450	Vehicle Lift						
14622	Overhead Crane						